Relationship of Readability and Suitability of a Hearing Aid User Guide and Self-efficacy of Hearing Aid Users: A Pilot Study

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Abstract

The aim of this study is to investigate whether revising an existing hearing aid user guide is associated with increased Hearing-Aid Self-efficacy of hearing aid users. In Part One, a hearing aid user guide was revised to bring readability and suitability in-line with the recommendations for written healthcare material. In Part Two, participants were provided with either the original guide (OG) or revised guide (RG). Self-efficacy was measured using the Measure of Audiological Rehabilitation Self-efficacy for Hearing Aids (MARS-HA). The participants' performance on hearing aid management tasks was also measured using a purpose-developed Utility test. There was a statistically significant relationship between user guide version and self-efficacy for both the Basic Handling Subscale (BHS; p = .008, Cohen's d= .858) and Advanced Handling Subscale (AHS; p = .045, Cohen's d= .722) scales of the MARS-HA. There was also a significant relationship between user guide version and Utility test score (p = .001, Cohen's d= 1.26). These results are encouraging as they indicate that there is scope to influence self-efficacy through the use of appropriate hearing aid user guides.

List of Abbreviations

4FA	Four-Frequency Average
AHS	Advanced Handling Subscale
ALLS	Adult Literacy and Life Skills Survey
BHS	Basic Handling Subscale
dBHL	Decibels Hearing Level
F-K	Flesch-Kincaid Grade Level
FRE	Flesch Reading Ease
HA-SE	Hearing Aid Self-efficacy
HHQ	Hearing Handicap Questionnaire
HI	Hearing Impairment
HHIE	Hearing Handicap Inventory for the Elderly
ICF	International Classification of Functioning, Health and Disability
LoC	Locus of Control
MARS-HA	Measure of Audiological Rehabilitation Self-efficacy for Hearing Aids
NZAS	New Zealand Audiological Society
OG	Original Guide
RG	Revised Guide
RGL	Reading Grade Level
SAM	Suitability Assessment of Materials
SE	Self-efficacy
SMOG	Simple Measure of Gobbledygook
WHO	World Health Organisation

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Chapter One: Introduction

Overview

Hearing impairment (HI) is a condition that can have a negative effect on health-related quality of life for individuals and society (Appolino, Carabellese, Fratolla, & Trabucchi, 1996; Kelly-Campbell & Lessoway, 2015; Pugh, 2004). It is also one of the most common health conditions in the ageing population (Chia, Wang, Rochtchina, Cumming, & Newall, 2007). While there are a number of rehabilitation options to assist people with a HI, hearing aids are a common intervention. Hearing aids have been shown to be effective, not only in improving access to sound, but also have social and psychological benefits (Bridges & Bentler, 1998; Chisolm, Noe, McArdle, & Abrams, 2007). However, despite the documented advantages of hearing aids for wearers, there is a low uptake and low successful use rate (Smeeth et al., 2002; Davis, Smith, Ferguson, Stephens, & Gianopoulos, 2007). Hearing aid self-efficacy (HA-SE) is one factor that can affect successful hearing aid uptake and use (Meyer, Hickson, Lovelock, Lampert, & Khan, 2014). Hearing aid user guides are a way of communicating information about hearing aids that may contribute to HA-SE. The current study investigates whether improving the readability and suitability of a hearing aid user guide is associated with increased HA-SE.

Hearing

The hearing mechanism

The process by which sounds from the outside world are transmitted, encoded and processed by the auditory system is detailed and complex. A sound vibration enters through the ear canal and vibrates the tympanic membrane (Martin & Clark, 2012). This causes the middles ear ossicles to move. As the stapes moves in the oval window, a wave is created in the inner ear liquid (Bess & Humes, 2009).

This travelling wave moves along the basilar membrane and forms a peak at the place that is most sensitive to the frequency of the sound (Patuzzi, 1996; von Békésy, 1960). The basal end of the basilar membrane is thin, stiff and sensitive to sounds with a low frequency; whereas the apical end of the basilar membrane is wide, flaccid and corresponds to lower frequency sounds (Ehret, 1978). The movement of the basilar membrane deflects the outer hair cells and allows endolymph to flow into the inner hair cells. The ions from the endolymph cause a depolarisation of the inner hair cells, which triggers the auditory nerve to fire (Bess & Humes, 2009). The outer hair cells expand and contract on the basilar membrane and can increase its vibration up to 65 dB (Nilson & Russell, 2000).

Hearing impairment

If a part of the hearing mechanism breaks down, energy is not transferred as efficiently. This causes a HI. HIs are often categorised into conductive, sensorineural and mixed. Conductive impairments include conditions affecting the outer and middle ear. Sensorineural impairments affect the inner ear and auditory neural pathway. Mixed impairment consists of both conductive and sensorineural components (Martin & Clark, 2012).

Sensorineural HI is caused by a problem in the inner ear or auditory nervous system. Common causes of sensorineural HI include congenital conditions, noise induced HI, and presbycusis (HI due to ageing) (Isaacson & Vora, 2003). According to Weinstein (2009), presbycusis affects many parts of the ear including thickening of the eardrum, reduction of endolymph production in the stria vascularis, and less efficient transfer of information. The hair cells and support cells on the Organ of Corti are most susceptible to deterioration as people age. Presbycusis generally presents as a symmetrical, bilateral sensorineural HI that is poorer in the high frequencies than the low frequencies and deteriorates slowly over time (Weinstein, 2009).

HI is one of the most commonly occurring health conditions in older people. Chia et al. (2007) tested the hearing of a sample of 2,956 participants. They reported that hearing deteriorated with age. At 50-59 years of age, 16% of the sample had a HI, at 60-69 years of age, 36% had a HI, at 70-79 years of age, 65% had a HI and in the over 80 years of age group, 88% had a HI. Cruikshanks et al. (1998) noted a similar trend in their data with the prevalence of HI increasing from 20.6% in the 48-59 year old age group to 90% in the 80-92 year old age group. Across Germany, France, the United Kingdom, Norway, Switzerland, Italy and Japan, the percentage of self-reported hearing loss has ranged from 8.8% to 12.5% (Hougaard, Ruf, & Eggar, 2012).

Consequences of hearing impairment

Health conditions such as HI can affect many different aspects of a person's life. The World Health Organisation (WHO, 2001) developed a disability framework for healthcare providers known as the International Classification of Functioning, Health and Disability (ICF). This model incorporates factors beyond the medical or biological aspects of a health condition. The ICF model takes into account social, environmental and other contextual factors. The physical level of the disease presentation is considered the impairment. Difficulty in completing a task or action is an activity limitation. Difficulties that may be encountered in social or other environmental situations are labelled participation restrictions (WHO, 2001).

In the case of HI, activity limitations and participation restrictions can include negative social and psychological consequences. A moderate positive correlation between audiological measures and social isolation was found by Weinstein and Ventry (1982). Severity of HI was significantly associated with hearing handicap and self-reported communication difficulties in a large population of older adults. Severity of HI had also been associated with poorer mental functioning (Dalton et al., 2003). Christian, Dluhy, and

O'Neill's 1998 study indicated that those with a HI experienced greater loneliness than those without. Strawbridge, Wallhagen, Shema, and Kaplan (2000) demonstrated that, as hearing becomes poorer, mental health and social functioning also tend to decline. Psychological effects of HI can include depression, anxiety, lethargy and social isolation (Heine & Browning, 2002).

Another participation restriction related to HI is lower employment rates for both younger and older people (Parving & Christensen, 1993). Danermark and Gelleratedt (2004) associated early retirement and high-stress in a work environment with HI. Kramer, Kapteyn, and Houtgast (2006) also found that employees with HI took sick leave due to stress more often than employees without HI. More recently, Shaw, Tetlaff, Jennings, and Southall (2013) conducted interviews and found social accommodations were required for successfully overcoming hearing related challenges in the work place.

A New Zealand study examining factors related to hearing related quality of life in the New Zealand context found that the negative impacts of HI on quality of life reported overseas are also evident in the New Zealand context (Kelly-Campbell & Lessoway, 2015).

Hearing Aids

Management of hearing impairment

There are a variety of options to assist people with a HI in managing their activity limitations and participation restrictions. Hearing aids are one option that can be offered to people with aidable HI. Other management options include hearing assistive technology, auditory training and communication strategies (Cardemil, Aguayo, & Fuete, 2014).

Hearing aids help overcome HI by amplifying sound. They can also manipulate aspects of the sound to target particularly difficult listening situations. Multichannel compression can be used to account for an individual's HI in different frequency regions (Dillion, 2012). Directional microphones can be used if the speaker is in a different direction from the background noise relative to the listener (Bentler, 2010), as background noise can diminish intelligibility for people with HI (Levitt, 2001). Hearing aids with directional microphones are more sensitive to sound coming from one direction than other directions (Bentler, 2010). Noise reduction algorithms use signal processing to reduce noise according to the spectral components of the sound (Dillon, 2012). Frequency transposition can be used to re-produce or compress higher frequencies into a lower frequency range so they are more audible (Ellis & Munro, 2015).

Benefits of hearing aids

The benefits of hearing aids have been well-documented for people with HI. Hearing aid use has been correlated with improved functional health status and significant improvement in communication function (Crandell, 1998). Hearing aid users had better scores in depression and life satisfaction measures than adults with HI who did not use hearing aids (Bridges & Bentler, 1998). Chisolm et al. (2007) conducted a systematic review of the literature on evidence pertaining to hearing-related quality of life for adults with sensorineural HI. Between-subject studies using disease-specific quality of life instruments indicated hearing aids had a medium-to-large effect on adults' hearing-related quality of life. Hearing aids were associated with reduced psychological, social and emotional effects of sensorineural HI; also, unmanaged HI was related to poorer quality of life.

Unaided HI can have a negative impact on functional life experience. Appolino et al. (1996) found that unmanaged HI was associated with impaired mood, and less self-sufficiency in everyday activities. This was not apparent in those individuals who were hearing aid users. They also found men with HI who did not wear hearing aids had a mortality rate twice that of those with good hearing sensitivity and those who used hearing aids.

Hearing aid uptake and usage rates

Even though there are clear benefits to hearing aid use, not all of the population of adults with HI own and use them successfully. In 2001, Kochkin found the percentage of people with HI who owned hearing aids in the United States was 22.2%. Smits, Kramer, and Houtgast (2006) reported a hearing aid ownership rate of 42% in 1,086 adults in Amsterdam. In another study, nearly half of the participants with hearing difficulties did not own a hearing aid (Smeeth et al., 2002). In addition, Fisher et al. (2011) noted that there was a low rate of hearing aid ownership (35.7%) among older adults in Wisconsin.

More recently, Öberg, Marcusson, Nagga, and Wressle (2012) surveyed a group of older Swedish adults about their hearing. They found 59% of the participants who reported a HI owned a hearing aid. A trade journal article surveyed hearing aid adoption across Europe and Asia including Germany, France, the United Kingdom, Norway, Switzerland, Italy, and Japan. Hearing aid adoption rates as a percentage of the self-reported population of adults with HI ranged from 42.5% in Norway to 14.1% in Japan (Hougaard, Ruf, & Eggar, 2012). The hearing aid ownership data varied considerably between countries. There could be a number of factors that contribute to this variation. These include cultural differences and differences in funding schemes. Also, study methodology, such as different hearing loss criteria (self-report or measured), may influence the rates reported by different studies.

Not all hearing aid owners use their hearing aids regularly. In 2000, Kochin reported 5% of hearing aid owners stopped using their aids in their first year. This increased to around a third after nine years of hearing aid ownership. Hearing aid owners in Sweden were surveyed by Bertoli et al. in 2009. They found 12% only use their devices occasionally and 3% never use their devices. Kahveci et al. (2011) reported around 7% used their hearing aids rarely or never. Data from the United Kingdom, Australia, Finland, Denmark, and the United States indicated that 1 to 40% of hearing aids dispensed are never or rarely used (Dillon, Birtles & Lovegrove, 1999; Hickson, & Worrall, 2003; Lupsakko, Kautiainen, & Sulkava, 2005; Smeeth et al., 2002). Hearing aid use can be a difficult concept to measure, as individuals can be reluctant to self-report limited hearing aid use. This could account for some of the variation in the rates of disuse.

Factors in hearing aid uptake

Hearing aid uptake is a complex issue. Three literature reviews have been conducted that include studies looking at factors related to hearing aid uptake (Ng & Loke 2015; Meyer & Hickson 2012; Knudsen, Öberg, Nielsen, Naylor, & Kramer, 2010). Regarding the likelihood for hearing aid uptake, the two most common themes that emerged were: 1) higher perceived activity limitation and participation restriction or handicap being associated with higher uptake rates (Duijvestijn et al., 2003; Fischer et al., 2011; Gussekloo et al., 2003; Helvik et al., 2008; Humes, Wilson, & Humes, 2003; Palmer, Solodar, Hurley, Byrne, & Williams, 2009; Popelka et al., 1998; van den Brink, Wit, Kempen, & van Heuvelen, 1996) and 2) more severe hearing losses were associated with increased hearing aid uptake (Fischer et al., 2011; Garstecki & Erler, 1998; Gussekloo et al., 2003; Helvik et al., 2008).

There were a number of other factors related to reduced hearing aid uptake. Some of these were attitudinal; such as perceived barriers to amplification including discomfort, low performance, and cost (Garstecki & Erler, 1998; Kochkin, 2007), stigma associated with HI (Kochkin, 2007; van den Brink et al., 1996; Wallhagen, 2010) and acceptance of hearing loss (Garstecki & Erler, 1998; Helvik et al., 2008).

Factors in hearing aid use

There is some overlap between hearing aid uptake factors and hearing aid use factors but there are also some differences. Literature reviews by Ng and Loke (2015) and Knudsen et al. (2010) also investigated factors relating to hearing aid use. A self-perceived hearing problem was the most significant non-audiological factor related to hearing aid use (Chang et al., 2009; Cox, Alexander & Gray, 2005; Fischer et al., 2011; Hartley et al., 2010; Hickson, Meyer, Lovelock, Lampert & Khan, 2014; Meister, Lausberg, Kiessling, von Wedel, &

Walger, 2008; Mizutari et al., 2013; Palmer et al., 2009). However, for measured severity of HI there was not a strong relationship with use. A relationship between HI severity and hearing aid use was found for some studies (Gatehouse, 1994; Bertoli et al., 2009) but not for others (Brooks & Hallam, 1998; Hickson et al., 1999; Hickson, Hamilton, & Orange (as cited in Knudsen et al., 2010) 1986; Jerram & Purdy, 2001).

Other factors were also related to hearing aid use. Pre-fitting attitudes towards hearing aids had a positive relationship to hearing aid use (Hickson et al., 1986; Wilson & Stephens, 2003). Also, those who were more accepting of their hearing problems were more likely to use their hearing aids (Brooks, 1989; Jerram & Purdy, 2001). In addition, if hearing aids were fitted closer to the prescription targets they were more likely to be used successfully (Hickson et al., 2014). If a person found listening to speech in background noise more acceptable, they were more likely to use the hearing aids (Nabelek, Freyaldenhoven, Tampas, Burchfield, & Muenchen, 2006).

Hearing aid user guides

Hearing aid user guides are often provided by the hearing aid manufacturer for the user to take home with them. They contain information about how the hearing aid works, how to take care of it, safety information, and how to solve common problems (Brooke et al., 2012). User guides are an important resource because new hearing aid users are given a large amount of new information. Not all of this is necessarily understood or remembered. In a review of the literature, Kessels (2003) found that around 40-80% of medical information provided to patients is forgotten. Margolis (2015) suggested that giving the client written information as a permanent record to refer to later was the most important way to maximise information retention. Simpler language, categorisation, repetition and specific, rather than general information, is more easily remembered (Ley, 1979).

It is also possible that a hearing problem may increase the likelihood that information is misheard or misunderstood. Poorer hearing is related to poorer episodic and long-term memory (Rönnberg et al., 2011). This suggests that written information, which can be referred to later, would be a helpful resource. User guides can be a valuable source of information if they are fit for purpose and the information can be understood.

Readability and Suitability of Written Health Materials

In order for hearing aid user guides and other written healthcare materials to communicate effectively they need to be written at a level the target audience can understand. Health literacy is a cluster of skills, including the ability to read and write, that are required to access and act appropriately on health information (Glassman, 2013).

General and health literacy

General literacy is related to, but distinct from, health literacy. According to the United States National Literacy Act 1991, literacy is the ability of an individual to read, write and speak as well as compute and solve problems. The literate individual has these skills at a level necessary to function in employment and in society. They are also able to use these skills to achieve their goals and develop their knowledge and potential. However, health literacy requires the ability to use these skills in the healthcare context (Mackie, 2012). The WHO published a Health Promotion Glossary in 1998, which included a definition of health literacy. “Health literacy represents the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health” (WHO Health Promotion Glossary, 1998, p.10). The American Medical Association Health Literacy Report (1999) noted that, in the healthcare system, individuals are often required to act on complex and unfamiliar information. Being able to make changes and take action is an important aspect of health literacy.

Importance of health literacy

Adequate general literacy skills may not translate to adequate health literacy skills. The health literacy ability of an individual may not be clearly related to their educational level or reading ability (Glassman, 2013). Functional health literacy is situation-specific (Kirsch, Jungeblut, Jenkins, & Kolstad, 2002). Those with low literacy may find an unfamiliar situation more challenging. If the healthcare setting is an unfamiliar environment for the user, this may mean it is more difficult for the user to understand and act on health related information (Ishikawa & Yano, 2008). Ishikawa and Yano (2008) also observed that the literacy requirements in healthcare settings are often more demanding than those in everyday life.

Tasks such as reading medicine bottles, finding appointment information and following a care plan may fall into this unfamiliar category. Therefore, it may be more difficult for them to understand this information (American Medical Association, 1999). An individual’s ability to access, understand and act on information about their health may have an effect on their health status, wellbeing and quality of life (Berkman et al., 2011; Halverson et al, 2015; Kazley et al., 2015; WHO, 2013). Many people have general literacy levels that are poorer than those required to successfully navigate the health system (Weiss, 2007).

Health literacy rates

A recent study from the Institute of Medicine (2012) reports 90 million American adults lack basic health literacy (Glassman, 2013). Limited health literacy is also a problem in Europe (Lambert & Keogh, 2014; Sørensen et al., 2015). In Australia literacy levels are similarly low. The Australian Commission on Safety and Quality in Healthcare produced a statement on health literacy in 2014. They stated around 40% of adults in Australia have individual health literacy levels below what is recommended. This means they may struggle to meet the complex health literacy demands of everyday life. The Commission also noted that, for older people, low individual health literacy is not only related to poorer health status but also to a higher risk of premature death.

Australia and New Zealand took part in the Adult Literacy and Life Skills Survey (ALLS) international literacy study (Satherley, Lawes & Sok, 2008). Results from the 2006 stage of the survey indicated that many New Zealanders have limited health literacy. The mean score for both Māori and Non-Māori fell below the minimum score for adequate health literacy skills. Inadequate health literacy skills can prevent individuals obtaining, processing and understanding basic health information in order to make informed and appropriate health choices (Manatū Hauora, Ministry of Health, 2010).

Literacy and health materials

There is a discrepancy between the health literacy skills of the population and the level at which written healthcare materials are produced (American Medical Association, 1999; Kirsch, Jungeblut, Jenkins, & Kolstad, 2002). The readability of healthcare materials can be measured in Reading Grade Level (RGL), which is the average number of years of education required in the United States to understand a textbook (Doak et al., 1996). Safeer and Keenan (2005) found the majority of healthcare materials are written at a tenth RGL, compared to the recommended sixth RGL (Doak et al., 1996; Ley & Florio, 1996). Discharge instructions from an emergency department (Jolly, Scott, Feied, & Stanford, 1993) and written paediatric patient education materials (Davis et al., 1994) were found to be written at levels that exceeded patient health literacy skills. Health literacy skills at tertiary level or above were reuired to understand three-quarters of consent forms (Morrow, 1980).

Population health literacy levels continue to be lower, on average, than the text of healthcare materials provided to healthcare users in many different disciplines. As demonstrated in table one, health materials are consistently written at a higher RGL than the recommended sixth RGL.

Table 1

Readability of Written Consumer Materials From a Range of Health Disciplines

Article	Readability (RGL)	Subject
Atcherson et al. (2014)	85.4% above 5-6	American Speech-Language-Hearing Association website.
Caposecco, Hickson and Meyer (2014)	Average 9.6	Suitability of hearing aid user guides for older adults.
Schmitt and Prestigiacomo (2013)	None at or below 6	Neuro-surgery related public health materials.
Patel, Cherla, Sanghvi, Baredes and Eloy (2013)	Range 10 - 14.9	Information material for thyroid surgery.
Neuhauser et al. (2013)	91% above 6	Emergency preparedness materials for Deaf and hard-of-hearing people.
Aleligay, Worrall and Rose (2008)	Average 9	Written health materials for people with aphasia.
Lindstrom (2007)	Average 8.77	Patient education documents. for veterans.
Cotugna, Vickery and Carpenter-Haefele (2005)	50% above 8	Patient education materials.
Adkins and Singh (2001)	Average 12.9	Patient and Family Fact Sheets.

Effect of literacy levels on health outcomes

Limited ability to access, understand, or act on health information can have a detrimental effect on health outcomes. This is an on-going issue. Kazley, Hund, Simpson, Chavin, & Baliga (2015) investigated health literacy and kidney transplant outcomes. They found that the literacy skills significantly predicted whether or not a patient was accepted for a kidney transplant.

Low ability to interpret labels and health messages correlated with poorer overall health status and higher mortality rates for older adults (Berkman et al., 2011). In 1987, Gibbs, Gibbs, and Heinrich found only 13% of their participants understood the word “terminal”, 18% understood “malignant”, and 35% “orally”. Low health literacy is consistently associated with more hospitalisations, more emergency care use, lower uptake of mammography screening and influenza vaccination and using medicine inappropriately (American Medical Association, 1999; Berkman et al., 2011; DeWalt et al., 2004).

Proposed solutions

Approaches have been suggested for addressing the discrepancy between the health literacy levels of the population and the readability of written healthcare materials. One approach is improving access to, understanding of and ability to act on health information (Nutbeam, 2000). Other research has focused on improving readability of written healthcare materials (Wilson et al., 2010). Additional aspects of written health materials that could be improved include text cohesion, organisation, layout, graphics, writing style, cultural factors, and the amount of information presented (Doak, Diok, Friedell, & Meade, 1998; Seligman et al., 2007).

The Australian Commission on Safety and Quality in Healthcare (2014) suggested that healthcare organisations use a range of modes of communication in order to ensure patients can understand their decisions. It is also helpful to have easy-to-read material (DeWalt, 2010). Well-designed materials that are easy to read are preferred by all levels of readers, not just those with low health literacy (Ley, 1993). Baker et al. (1996) interviewed patients with low literacy. Their preference was for information that is relevant to them, simple and easy to understand.

Results from a large study looking at patient understanding of consent forms suggested that the RGL of a consent form for a mouth washing procedure affected the participant's understanding of the information (Young, Hooker, & Freeberg, 1990). In another study, Davis et al. (1996a) compared polio vaccine information pamphlets. One pamphlet had a sixth RGL, was shorter, and had simple graphics. The other was longer, had no graphics and had a tenth RGL. Average comprehension was higher for the first pamphlet than the second (Davis et al., 1996b).

Culturally appropriate information is also important for understanding health materials. Information needs to be presented in a way that is sensitive to the way a particular population accesses and communicates health information (Lubetkin et al., 2015).

Health literacy in audiology

The ageing population has a higher prevalence of HI and has lower literacy rates than their younger counterparts. Demographic information indicates that the median age of New Zealanders is increasing (Tatauranga Aotearoa Statistics New Zealand, 2015). Functional health literacy declines on average 1.3 points per year (Baker, Gazmararian, Sudano, & Patterson, 2000). As hearing aid users are often older (Weinstein, 2000), providing resources that are at an appropriate level for their health literacy skills is important. Safeer and Keenan (2005) suggested older patients are particularly affected because their reading and comprehension abilities are influenced by cognition, vision and hearing status.

Gazmararian (1999) found managed care patients aged 65 years or older have limited ability to read and comprehend written medical materials. Reading ability declined dramatically with age, even when accounting for education and cognition. The percentage of participants with inadequate health literacy increased from 15.6% in the 56-59 year age bracket to 58.0% for those over 85 years of age. Another investigation looking at audiology and health literacy found younger age was associated with completing self-fitting hearing aid tasks more independently (Convery, 2013).

Like other health disciplines, audiology patient materials are often written at a level that is higher than the recommended sixth RGL. Laplante-Lévesque and Thorén (2015) conducted a review of the literature on the readability of Internet-based information for people with HI and their significant others. The RGL in these studies ranged from 9-14. Caposecco et al. (2014) analysed the content, design and readability of hearing aid user guides printed by hearing aid manufacturers. The results indicated that 69% of guides were "not suitable" and 31% were "adequate" for the intended users. Low scores were given for scope vocabulary, layout, typography and learning motivation. Mean RGL was found to be 9.6, which is higher than recommended for older adults. This demonstrates that there is room for improvement of hearing aid user guides.

Self-efficacy and Health

The discrepancy between the health literacy skills of the population and the reading level of hearing aid user guides could contribute to lower confidence for using hearing aids or inadequate hearing aid self-efficacy (HA-SE).

What is self-efficacy?

Self-efficacy (SE) is the belief an individual has, that they can carry out a behaviour or achieve an expected outcome (Bandura, 1977). SE is situation-specific. A person can have high SE in one area such as adhering to a healthy diet but low SE in another, such as public speaking skills (Smith & West, 2006a). SE is a separate construct from self-confidence, Locus of Control or self-esteem (Clark & Dodge, 1999). SE is not an isolated concept but part of an interaction of personal, behavioural and environmental factors that produce behaviour (Bandura, 1997).

The concept of SE was developed by Albert Bandura. Bandura argued that an individual's perception of SE can influence behaviour, choice of activities, choice of environment and enhance or impair performance. SE may contribute to how much effort a person puts into an activity and how persistent they will be if they encounter obstacles (Bandura, 1978, 1989).

Four key factors contribute to SE expectations (Bandura & Adams, 1977; Bandura, 1997, 1998).

1) Performance accomplishments.

Performance accomplishments come from personal mastery experiences. If an individual successfully completes a task, then they have higher mastery expectations. If they fail to complete a task, they will have lower mastery expectations. This is the most efficient method of improving SE (Bandura, 1998).

2) Vicarious experiences.

Vicarious experiences result from seeing others' experiences or performance. If others can complete a task successfully without adverse consequences, they may feel more confident about performing the task themselves (Bandura, 1997).

3) Verbal persuasion.

If people are lead to believe they can do something via suggestion, they are more likely to feel confident about completing it. Verbal persuasion is also more effective if it is provided by a credible and trustworthy person and can encourage greater effort (Bandura, 1997).

4) Emotional arousal.

If a successful outcome is expected, more positive emotions will be experienced. If an unsuccessful outcome is expected, negative emotions will be experienced. If a situation makes someone feel anxious and fearful, this may indicate that this is a situation in which they are not competent (Bandura 1977, 1978b).

Self-efficacy in health promotion

If SE affects how likely a person will attempt, persevere with or complete a task, then this can be applied to health-related tasks. In a systematic review, Strecher, DeVellis, Becker, and Rosenstock (1986) found SE was correlated with initiating and maintaining health behaviour change. For smoking cessation, contraception use, alcohol abuse and overcoming barriers, SE appears to be a predictor of behaviour change (Clark & Dodge, 1999; Forcehimes & Tonigan, 2008; Gwaltney, Metrik, Shiffman, & Kahler, 2009; McKinney, 1982).

Patients' perceptions of SE regarding how well they are able to cope can affect interventions. This was shown in a wide variety of studies including: pain management, eating, weight loss and preventative health programs. These results highlight the importance of health-related SE as a factor affecting health outcomes (O'Leary, 1985).

Self-efficacy in audiology

SE in audiological rehabilitation research is a new and developing topic. Smith and West (2006a) applied health SE principles to audiologic rehabilitation. HA-SE is thought to be predictive of long-term hearing aid use (West & Smith, 2007). Dullard and Cienkowski (2015) addressed the available evidence for the relationship between HA-SE and hearing aid management. Based on available evidence, HA-SE was significantly correlated with hours of hearing aid use.

Readability and suitability of written audiology information may have an effect on SE. Donald and Kelly-Campbell (2016) administered a SE questionnaire for understanding a paediatric audiology report. Results indicated that report understanding SE levels were higher in a report revised for readability and suitability than an unrevised report.

SE is an attitudinal factor that may affect hearing aid outcomes. SE is an individual's confidence in their ability to perform a specific task (Bandura, 1977). Kelly-Campbell and

McMillan (2015) explored the relationship between HA-SE and hearing aid satisfaction. Those with higher adjustment SE reported greater satisfaction for the aspects of aided listening. Low confidence in handling and communicating with hearing aids was related to lower perceived value of hearing aids and lower perception of the provider. High SE for complex listening environments was associated with more satisfaction for adverse listening conditions. The authors suggested that if SE could be increased, hearing aid users may be more satisfied with their hearing aids.

Abraham and Sheeran (2005) noted that there has been relatively little attention devoted to SE as a factor in hearing aid uptake, per the literature. Meyer et al. (2014) measured SE for basic hearing aid handling skills. They found that the average certainty that successful hearing aid owners reported for completing basic hearing aid-related tasks was 98%. However, causality could not be established as it was a retrospective study. They also recommended that research should further investigate the impact of client education on hearing aid management SE and hearing aid uptake. Meyer et al. (2014) also noted many older adults experience less than optimal HA-SE. More research into intervention strategies for promoting HA-SE in older adults was recommended.

Self-efficacy and hearing aid outcomes

Low HA-SE may be a barrier to hearing aid help-seeking, uptake and successful use. SE for managing a hearing aid appeared to be an important factor in the decision to seek help for a hearing problem (Meyer et al., 2014).

A person is considered a hearing aid owner if they have acquired a hearing aid (Meyer, Hickson, & Fletcher, 2014). It has been suggested that low hearing aid ownership rates may be influenced by low SE for learning how to use and take care of hearing aids (Kricos, 2000). Some hearing aid owners use their hearing aids successfully and others do not (Meyer, Hickson, & Fletcher, 2014). Greater SE for hearing aid advanced handling has been found to be a factor related to successful hearing aid use. Those with more positive attitudes and higher HA-SE have a greater likelihood of wearing hearing aids regularly and reporting benefit with them (Carson & Pichora-Fuller, 1997; Hickson et al., 2014;).

Factors in hearing aid self-efficacy

Factors that are related to improving HA-SE were investigated by Meyer, Hickson, and Fletcher (2014) using a retrospective study design. Non-hearing aid owners reported higher HA-SE if they had no visual disability, had a HI for longer, experienced more positive support from a communication partner and were not anxious about wearing aids. Hearing aid owners were more likely to report higher HA-SE if they had a positive hearing aid experience and no visual disability.

Hearing aid user guides may have a role in improving HA-SE (Caposecco et al., 2014). Meyer et al. (2014) found HA-SE may be improved by writing informational material about hearing aids at the recommended readability levels and using health literacy principals. User guides should be designed appropriately for older adults. Known problems include scope, layout, typography, vocabulary, and reading level. Information could also be provided in the form of a video (Doak et al., 1996). Kelly et al. (2013) interviewed older adults about what they consider helpful in adjusting to and getting the most out of, their hearing aids. Common themes were: providing practical support after their fitting, more hearing aid information and psychosocial care.

Counselling should continue until HA-SE is moderately-high and stable as indicated by an adequate score of more than 80% HA-SE on the Measure of Audiological Rehabilitation Self-efficacy for Hearing Aids (MARS-HA; Smith & West, 2006b; Meyer, Hickson, & Fletcher, 2014). The MARS-HA is described in detail in the methods section. One goal of the hearing aid fitting or training appointment is to increase the user's HA-SE (Smith & West, 2006a). Increasing HA-SE in older patients may mean they become more motivated to use their hearing aids, persevere when difficulties arise and apply more effort to successful hearing aid use.

Improving hearing aid self-efficacy

Bandura's theory of SE can be applied to HA-SE. SE may influence motivation, choice of activities and acquisition and refinement of new skills (Bandura, 1997). The four sources of information that contribute to SE beliefs (Bandura, 1997) can be utilised to help optimise HA-SE.

Mastery experiences can increase SE belief if the individual completes a task successfully (Bandura, 1997). Smith and West (2006a) gave suggestions for improving HA-SE using mastery experiences. These included starting with the easier tasks so as to increase confidence then, with practise, moving to more difficult tasks. New skills could also be divided into small steps or achievable goals could be set. Other suggestions included: starting simple, offering practise, practising at home straight away for reinforcement, engaging in role play and setting clear, specific goals.

Vicarious experiences are observations of other people completing a task. With cognitive rehearsal, individuals can visualise themselves performing the task successfully (Bandura, 1997). Smith and West (2006a) recommend using a video to demonstrate confident completion of hearing aid tasks. Other suggestions include videoing the user completing a task well, having a significant other complete the task well and visualising completing the task successfully.

Verbal persuasion occurs when others express confidence in an individual's skills and can influence SE (Bandura, 1997). Positive feedback can enhance SE. Smith and West (2006a) suggest that HA-SE can be improved using verbal persuasion by providing realistic feedback, encouraging significant others to learn skills and ensuring the audiologist gives constructive comments as well as demonstrating the skills.

Physiological and affective states can affect an individual's SE. Smith and West (2006a) gave specific applications to audiology. These included providing written and audio-visual material that the client can review later to reduce anxiety during the fitting session, providing adequate time for learning, stopping the task if the client seems distressed, attempting to determine the cause of anxiety and beginning with simple tasks. There is more research needed into the effects of SE on auditory rehabilitation (Kricos, 2006; Meyer et al., 2014).

Measures

There are a number of tools that have been produced for assessing and revising health materials. These include Suitability Assessment of Materials tool (SAM; Doak et al., 1996) and readability formulas. Some commonly used readability formulas include the Simple Measure of Gobbledygook (SMOG; McLaughlin, 1969), Flesch-Kincaid (F-K; Kincaid et al., 1957) grade level and Flesch Reading Ease (FRE; Flesch, 1948) readability formulas. HA-SE is often assessed using the Measure of Audiologic Rehabilitation Self-efficacy for Hearing Aids (MARS-HA) questionnaire. Utility testing tools can also be useful in measuring hearing aid management skills (Brooke et al. 2012).

Part One: Revision of the user guide.

There are a number of general recommendations to ensure health materials are appropriate for their intended user. The guidelines for creating easy to read health materials from the United States National Library of Medicine (2015) are:

1. Plan and research the target audience.
2. Organise and write materials taking into account language, style and visual presentation.
3. Evaluate and improve using readability formulas.

4. Inform and stay informed of new information. (How to write easy-to read health materials: Steps 1 to 4)

Doak et al. (1996) give the following recommendations for developing printed health education materials:

1. Set realistic objectives.
2. To change health behaviours, focus on behaviours and skills.
3. Present context first. State purpose or relate new information to old.
4. Partition complex instructions. Break them up into smaller portions.
5. Make it interactive. Consider including “write”, “show”, “tell”, “select” or “solve” sections for the patient to complete to reinforce the material.

Suitability Assessment of Materials (SAM)

Doak et al. (1996) developed SAM as a practical way of assessing the suitability of written health materials for a particular population. Meade and Smith (1991) recommend using SAM because it goes beyond readability as an indication of the suitability of a written material. SAM is endorsed by the Food and Drug Administration (Wolf, Davis, Shrank, Neuberger, & Parker, 2006) and the National Library of Medicine (2013).

The authors recommend the following six steps for using SAM:

1. Become familiar with the SAM factors and evaluation process.
2. Write a brief statement about the purpose of the material.
3. For a long material select a section to evaluate or use all of a short material.
4. Give a score from zero to two for each of the 22 factors.
5. Add the factor scores to give a total suitability score. Convert to a percentage.
6. Look at areas that could be improved and consider how this might be done.

SAM assesses six areas related to readability and comprehension taking into account context, layout and meaning. The six areas are:

1. Content
2. Literacy demand
3. Graphics
4. Layout and typography
5. Learning stimulation and motivation
6. Cultural appropriateness

Each area is divided into factors. Each of the 22 factors is given a rating and a corresponding score from zero to two as demonstrated in table two.

Table 2

Suitability Assessment of Materials Factor Scoring Matrix

Rating	Score
Superior factor	2
Adequate factor	1
Not suitable factor	0

N/A can also be used if a particular factor does not apply to that material. In this case, no is score given and that factor does not contribute to the overall score.

The overall SAM score is expressed as a percentage of the total items. The score that falls into either the “superior”, “adequate” or “not suitable” categories is shown in table three.

Table 3

Suitability Assessment of Materials Overall Scoring Matrix

Overall rating	Overall percentage score
Superior material	70-100
Adequate material	40-69
Not suitable material	0-39

SAM has been found to be valid and reliable. It is one of the few suitability measures that have been standardised for healthcare materials (Nair & Cienkowski, 2010). SAM was developed under the John Hopkins School of Medicine project “Nutrition Education in Urban African Americans” (1993). Doak et al. (1996) refined and validated SAM with 172 healthcare providers from several cultures. These cultures included Asian, Native American and African American. SAM has also been translated into Chinese and validated for use in Taiwan (Mei-Chuan, Chen, Gau, & Tzeng, 2014). Initial validation was completed by Doak, Doak, Miller, and Wilder (1994). Inter-rater reliability was also found to be acceptable (Hoffmann & Lander, 2012).

SAM is the most widely used rating scale for assessing the suitability of printed healthcare materials (Caposecco et al., 2014). It has been used with written patient health information in a number of different disciplines including stroke patient education materials (Eames, McKenna, Worrall & Read, 2003; Hoffmann & Lander, 2012), diabetes patient materials (Guinn, 2013; Wallace, Keenum, Roskos, Koopman, & Young, 2008), cancer patient materials (Finnie et al., 2010; Smith et al., 2014; Weintraub, Maliski, Fink, Choe, & Litwin, 2004) and physical activity education materials (Vallance & Lavellee, 2008). Ryan et al. (2014) used SAM to determine suitability of stroke, cancer and maternal-child materials because of its qualities as a rigorous and quantifiable measure of written materials provided to patients.

SAM has also been used in audiology to assess the appropriateness of hearing aid user guides for the hearing aid population (Caposecco et al., 2014; Caposecco, Hickson, & Meyer, 2011). Written health education materials can only be effective if they are written and designed in such a way that they can be read, understood and remembered by the target user (Hoffman, 2004). SAM appears to be a helpful tool in this process.

Readability formulas

There are a number of formulas available for assessing the readability of written materials. Readability formulas have been used to measure the readability of newspapers, education materials, farming leaflets and children's books (Flesch, 1948). They are now being used to ensure healthcare materials are written at an appropriate level for the majority of the population. Readability is calculated based on text factors and often expressed in RGL. Common variables used in reading formulas are number of syllables in words, number of words in sentences, common words, polysyllabic and monosyllabic words (Ley & Florio, 1996).

Readability formulas can be validated using different methods. Some use a Cloze procedure. Typically, in a Cloze procedure, every fifth word is replaced with a blank space. The participants insert the word they believe should go in the blank space (Taylor, 1953). Other readability formulas have been validated using the McCall-Crabb Passages. These passages were originally used for measuring the reading comprehension of school children (McCall & Crabb, 1925, 1950, 1961).

Three formulas that are widely used in research are F-K, SMOG and the Fry Readability Graph (Shieh & Hosie, 2008; Meade & Smith, 1991). An overview of readability tool used in audiology literature can be found in table four.

Table 4

Readability Formulas Commonly Used in Healthcare

Readability Formula	Sample	Variables	Interpretation
Flesch-Kincaid Readability Formula (F-K) (Kincaid et al., 1975)	Three 100-word passages	Sentence length in words and number of syllables in those words	Reading Grade Level
Flesch Reading Ease Scale (FRE) (Flesch, 1948)	Three 100-words passages	Sentence length in words and number of syllables in those words	Score from 0 (hardest to read) to 100 (easiest to read)
SMOG (McLaughlin, 1969)	Three samples of 10 sentences (30 sentences total)	Number of words with more than two syllables	Reading Grade Level
FOG Index (Gunning, 1968)	100 consecutive words	Sentence length in words and number of syllables in those words	Number of years of formal education required to read the text
FORCAST (Caylor, Sticht, Fox & Ford, 1975)	150 words	Number of monosyllabic words	Reading Grade Level
Fry Readability Graph (Fry, 1968)	Three 100-words passages	Sentence length in words and number of syllables in those words	Reading Grade Level
Dale-Chall formula (Dale & Chall, 1949)	Undefined	Familiar and unfamiliar words	Reading Grade Level

References: Caposecco et al., 2014; Friedman & Hoffman-Goetz, 2006; Hedman, 2013; Hooke, 1979; Nair & Cienkowski, 2010.

Friedman and Hoffman-Goetz (2006) discussed common limitations of readability formulas in a systematic review. One of these limitations is that formulas only measure text factors, not visual or design factors that could influence understanding. They cannot consider reader factors like prior knowledge, motivation and comprehension but are predictive (Bailin & Grafstein, 2001). Automated readability formulas may not differentiate headings, bullets, numbers with decimals and abbreviations. Also, readability formulas cannot tell the difference between ordered and nonsense sentences yet comprehension is affected by word order. They cannot account for differences between individual readers or situations (Doak, Doak, Freidell, & Meade, 1998).

In the field of audiology, research has utilised readability formulas. Kelly (1996) studied the readability of hearing aid brochures. Three formulas were used for the analysis: FOG index, Flesch index and Fry's index. A computer was used to calculate the readability of 109 documents. It was found that 58% of brochures required reading ability at tertiary level to be understood. In light of these findings, Kelly argued that readability analysis should be part of routine spelling and grammar checks for health materials.

Laplante-Lévesque, Brännström, Andersson, and Lunner (2012) investigated the quality and readability of English-language Internet information about HI, for adults. The FRE, F-K and SMOG readability formulas were used because there was precedence for using these particular readability formulas in Internet health information. Commercial websites had variable readability and the average years of education required to read the materials was 11-12. Similar results were obtained when different readability formulas were used indicating good validity. F-K and SMOG were positively correlated, while FRE was negatively correlated with F-K and SMOG. This can be seen in table five. Readability has appeared in the audiology literature in the last five years. Many studies use more than one formula and the most popular formulas are F-K, FRE and SMOG. It has been recommended that measures be made with more than one readability formula in order to account for differences in criteria (Friedman, 2006; Wallace, Turner, Ballard, Keenum, & Weiss, 2005).

Table 5

Readability Formulas Used in Recent Audiology Related Studies Addressing Written Patient Information

Paper	Readability formula(s) used							Subject of investigation
	F-K	FRE	SMOG	Gunning FOG	FOR CAST	Fry	Dale-Chall	
Donald and Kelly-Campbell (2016)	×	×	×					Paediatric audiology report.
Atcherson et al. (2014)	×	×		×	×			American Speech-Language-Hearing Association (ASHA) website.
Caposecco, Hickson, and Meyer (2014)	×	×		×		×		Suitability of hearing aid user guides for older adults.
Joubert and Githinji (2014)			×					Paediatric hearing pamphlets in South Africa.
Cherla et al. (2013)	×	×	×	×				Internet-based patient education material on acoustic neuromas.
McKearney and McKearney (2013)	×	×						Online grommet information for patients.
Eloy et al. (2012)	×	×	×	×	×	×	×	Major otolaryngology websites.
Laplante-Levesque et al. (2012)	×	×	×					Internet information for adults with HI and their significant other.
Caposecco, Hickson, and Meyer (2011)		×						Self-fitting hearing aid user manual.
Nair and Cienkowski (2010)	×							Spoken language in hearing aid counselling sessions and instruction manuals.

Flesch Reading Ease (FRE): The FRE readability formula was first developed by Flesch in 1943 to address a need for scientific readability tools. It was constructed using the McCall-Crabbs Standard Lessons in Reading. Regression analysis was used to assess the relationship between variables (Flesch, 1943). A number of studies have supported the validity of the FRE (Murphy, 1947; Stevens & Stone, 1947).

The original (1934) formula has a scoring range from 0 (very easy) to 7 (very difficult). It became apparent there was possibility for misinterpretation (Flesch, 1948). In 1948, Flesch addressed this issue and updated the earlier formula. The scoring method was also changed so that the maximum readability was 100 and minimum readability was 0.

Using the 1948 formula, the reading ease of a text was able to be calculated separately. The features of the text that were measured for reading ease were average sentence length in words and average word length in syllables. The reading ease formula has gone on to be more widely used than the human interest formula.

The FRE or reading ease formula is applied using the following method (Flesch, 1948, pp. 228-230):

1. Take three sample passages.
2. Count out 100 words for each sample.
3. Count the syllables in the samples.
4. Calculate the average words per sentence for the combined samples.
5. Calculate the reading ease score by using the following formula:

Flesch Reading Ease (FRE) formula

Reading ease = 206.835 – .846wl – 1.015sl

wl = word length, sl = sentence length

Substitute the sentence and word length into the formula.

The resulting number or reading ease score will be between 0 (practically unreadable) and 100 (easy for any literate person) as demonstrated in table 6.

Table 6

Interpretation of FRE formula scores, adapted from Flesch (1948, p.230)

Score	Reading ease
90-100	Very easy to read
80-89	Easy to read
70-79	Fairly easy to read
60-69	Average reading difficulty
50-59	Quite difficult to read
30-49	Difficult to read
0-29	Very difficult to read

Flesch-Kincaid Readability Formula (F-K): The F-K readability formula was developed by Kincaid et al. (1957) by simplifying the FRE for Navy use. The FRE score (out of 100) is inversely proportional to grade level used by F-K. Instead of predicting "reading ease" which requires a conversion to grade level, the F-K is calculated in RGL.

Test results from 531 Navy personnel were used to develop the F-K. Comprehension levels on the Gates-McGinitie Reading Test and Rate Training Manuals were measured. These results were used to calculate RGL and complete multiple regression analysis.

Microsoft Word can calculate FRE and F-K automatically. There is a very high correlation between manual and computer scoring (Friedman & Hoffman-Goetz, 2006).

Flesch-Kincaid Readability Formula

(Adapted from Kincaid et al., 1957, p. 14)

Old: Reading Ease = 206.835 - .836 (syllables/100 words) -1.015 (words/sentence)

New: Grade Level = .39 (words/sentence) +11.8 (syllables/word) - 15.59

Simplified: Grade Level = .4 (words/sentence) + 12 (syllables/word) – 16

In order to apply the F-K readability formula,

1. Count the number of words in the material or sample.
2. Count the total number of sentences.
3. Count the total number of syllables.
4. Calculate the average sentence length.
5. Calculate the average number of syllables per word.
6. Substitute the numbers into the formula and calculate the reading level (adapted from Kinciad et al., 1957, p. 39-40).

F-K grade level indicates the grade level reading skill required to comprehend the material. The United States department of defence uses the F-K as the official standard readability formula (McClure, 1987). Both the FRE and F-K readability formulas are calculated based on an assumption of 75% comprehension, and are therefore criticised as underestimating the readability of a passage (D'Alessandro, Kingsley, & Johnson-West, 2001).

F-K is one of the most common of the available readability formulas (Atcherson, 2009), and has been used extensively in audiology related literature (Donald & Kelly-

Campbell, 2016; Atcherson et al., 2014; Caposecco et al., 2014; Cherla et al., 2013; McKearney & McKearney, 2013; Eloy et al., 2012; Laplante-Levesque et al., 2012; Nair & Cienkowski, 2010).

Simple Measure of Gobbledygook (SMOG): The SMOG readability formula was developed by McLaughlin in 1969. The SMOG was validated using the McCrall-Crabbs Standard Test Lessons in Reading. The reading level of each lesson was the grade at which participants understood 100% of the material. Therefore, SMOG tends to score one to two grade levels higher than FRE and F-K. The SMOG is highly correlated with the FRE, F-K, and Fry Readability Graph (Meade & Smith, 1991).

Regression equations have been used to show prediction ability down to sixth RGL (McLaughlin, 1969). SMOG is fast and simple as well as being widely used in health research (Meade & Smith, 1991).

The SMOG formula can be used for assessing and revising documents. In order to revise a document using SMOG, use the formula to calculate RGL. Then, assess whether it is above or below Doak et al.'s (1996) recommended sixth grade reading level. At this level 75% of Americans should be able to easily understand it.

To apply the SMOG readability formula:

1. Select 10 consecutive sentences from the beginning of the material, 10 from the middle and 10 from the end.
2. For these 30 sentences, count the words containing three or more syllables including repetitions.
3. Calculate the nearest perfect root square of the number of words with three syllables or more.
4. Add a constant of three to give the final RGL (adapted from McLaughlin, 1969, p. 639).

Part Two: Hearing aid Self-efficacy and Utility

In Part Two of the study, HA-SE Utility scores were measured in order to determine if there was a relationship between the user guide revision and HA-SE. HA-SE was measured using the MARS-HA. Utility was measured using a purpose-design scoring matrix based on Brooke et al.'s (2012) method. This was used to verify the effectiveness of the user guide revision.

The Measure of Audiologic Rehabilitation Self-efficacy for Hearing Aids (MARS-HA)

SE is measured by asking individuals whether or not they are capable of performing a task. In order to measure accurate and honest results, responses should be recorded privately rather than stated publicly (Bandura, 1982).

The MARS-HA questionnaire was designed by Smith and West (2006b) because of the need for a tool to measure HA-SE. Psychometric properties were evaluated with both new and experienced hearing aid users. There was good internal consistency and test-retest reliability both overall and within the subscales. Validity was established by looking at expected differences in group comparisons and training effect (West & Smith, 2007).

The MARS-HA consists of four subscales:

1) Basic handling of hearing aids

   Example: *I can insert a battery into the hearing aid with ease.*

2) Advanced handling

   Example: *I can troubleshoot a hearing aid if it stops working.*

3) Adjustment to hearing aids

   Example: *I could get used to the sound of my own voice if I wore hearing aids.*

4) Aided listening

   Example: *I could understand conversation in a small group while in a noisy place if I wore hearing aids.*

These four subscales consist of 24 individual response items. Responses are recorded on a continuum from 0 to 100% based on the confidence that the user feels about completing a particular task. The percentages are presented at 10-point intervals and a response is indicated by circling a percentage. HA-SE is calculated for each subscale by taking the average of the responses. Higher percentage scores indicate greater HA-SE. Lower percentage scores indicate lower HA-SE.

The MARS-HA has been used in the audiology literature. Smith et al. (2013) utilised the MARS-HA in developing a survey on hearing aid style preference. Meyer et al. (2014) used the MARS-HA to measure HA-SE when investigating factors that affect help-seeking in older adults with HI. Adequate HA-SE is considered a score of 80% or higher in the MARS-HA (Meyer, Hickson & Fletcher, 2014; West & Smith, 2007).

Utility testing

Utility testing is a valuable clinical and research tool (Brooke et al., 2012). Utility testing is the process of evaluating a product by trialling it with the target users. A sample of the intended user group is given a series of tasks to complete using the material. These tasks are scored in order to determine the usability of the product (Doak et al., 1996). A minimum of 10 participants per cohort is recommended by the Medicines and Healthcare Products Regulatory Agency (2005) for user-testing.

Brooke et al. (2012) used performance-based Utility testing as part of evaluating two hearing aid instruction booklets. The Utility tasks focused on basic maintenance. Hearing aid naïve participants were tested as previous experiences are likely to influence hearing aid management skills. Participants were asked to perform tasks by using the instructions in the user guides. They could refer to the manual if they wished during the Utility testing. Tasks included cleaning and maintaining the hearing aids. The order of the tasks was not the same as the order in the instruction booklet. The tasks were rated “completed”, “completed with difficulty", "partially completed" and "not completed" depending on whether the aid was ready for use or not.

Locus of Control

Locus of Control (LoC) was first described by Rotter (1954). It is a concept that measures to what extent an individual feels they have control over events in their lives. LoC can be internal or external. People with a higher internal LoC have a higher belief that they can influence events in their life. A higher external LoC (lower internal) indicates that an individual attributes events to forces beyond their control (Sullivan, 2009).

Various authors have identified LoC as a multi-dimensional construct. Levenson modified Rotter's (1966) Internal-External LoC scale in order to account for Powerful Others and Chance components as well as Internal LoC. The Internal LoC factor measures to what extent an individual feels they can control events around them. The Powerful Others factor measures to what extent an individual feels events in their life are controlled by influential people around them. The Chance factor measures to what extent an individual feels events in their life are controlled by random events (Levenson, 1974).

Levenson scales are scored by administering a questionnaire in which questions from the 3 subscales are combined randomly. The available responses are at integer intervals from -3 to +3. The responses for every item in the scale are added. A constant of 24 is added to give a final score for each factor. The relationship between HA-SE and LoC has not been previously investigated.

Aim and Hypothesis

Aim of study

The aim of this study was to investigate whether revising an existing hearing aid user guide to improve readability and suitability leads to increased HA-SE. Whether this revision was associated with improved ability to complete hearing aid tasks was also investigated with a Utility assessment.

Main hypothesis

The main hypothesis of this study was that HA-SE and ability to use the aids would be higher for the group using the revised guide (RG) than the group using the original guide (OG).

Specific predictions:

1. Part One
    a. It was expected the RG would have a lower readability score on the SMOG and F-K and a higher score on the FRE than the OG.
    b. It was expected the RG would score more highly on the SAM than the OG.
2. Part Two
    a. It was expected HA-SE would be higher for the group that used the RG than the group that uses the OG.
    b. It was expected that the group that used the RG would score more highly in the Utility testing than the group that used the OG.
    c. It was expected that HA-SE and Utility testing score would be positively correlated.

Other predictions

Locus of Control

It was predicted that as BHS scores on the MARS-HA increase:

a. The Internal LoC factor scores would increase
b. The Powerful Others factor scores would decrease
c. The Chance factor scores would decrease

It was predicted that as AHS scores on the MARS-HA increase:

d. The Internal LoC factor scores would increase

e. The Powerful Others factor scores would decrease

f. The Chance factor scores would decrease

Familiarisation time:

d. It was expected that there would be a relationship between familiarisation time and HA-SE.

e. It was expected that there would be a relationship between familiarisation time and Utility task score.

Demographic factors:

The OG and RG groups were not expected to be significantly different on demographic factors, audiological factors or Levenson scale scores.

Chapter Two: Methods

Overview

The purpose of this study was to investigate whether revising an existing hearing aid user guide increases Self-efficacy (SE) of hearing aid use in adults with a hearing impairment (HI) who have never worn hearing aids. In Part One of this study, a hearing aid user guide was revised using written healthcare material readability and suitability guidelines. In Part Two of the study, the HA-SE of participants using the original guide (OG) or revised guide (RG) was compared. This chapter describes participants, materials and procedures used for each part of this study.

This study addressed the need for more information about HA-SE. Specifically, whether improving the readability and suitability of a hearing aid user guide is associated with improved HA-SE. Suitability of the OG and RG was measured using the Suitability Assessment of Materials (SAM; Doak et al., 1996). Readability was assessed using the readability formulas Simple Measure of Gobbledygook (SMOG; McLaughlin, 1969), Flesch-Kincaid (F-K; Kincaid et al., 1957) grade level and Flesch Reading Ease (FRE; Flesch, 1948). HA-SE was measured using the Measure of Audiologic Rehabilitation Self-efficacy for Hearing Aids (MARS-HA; Smith & West, 2006b) questionnaire. A purpose-built Utility testing tool was used to quantify hearing aid management skills.

Part One: User Guide Revision

Materials and procedures

This section describes the materials and procedures used in Part One of this study. The material selected for this study was an Oticon Alta mini receiver in the canal (RIC) hearing aid and its user guide. This specific hearing aid model was selected for two reasons. First, a RIC style hearing aid was required for Part Two of this study. Second, in a previous study (Russell, 2015 unpublished work), the user guide for this RIC aid was assessed for its readability, suitability, and acceptability. The combined readability and suitability score along with consumer acceptability indicated that it was not adequate for consumers.

Readability

Readability was assessed using Readability Studio (Windows) 2012.1 software. The composition of the document was "narrative text", the layout was "centred/left-aligned", and the document type was "technical report". The PDF version of the user guide was downloaded from the Oticon website and submitted to the readability analysis. Three readability formulas were selected to assess the document: (1) Flesch Reading Ease (FRE; Flesch, 1948), (2) Flesch-Kincaid Grade Level (F-K; Kincaid, Fishburne, Rogers, & Chissom, 1975), and (3) Simple Measure of Gobbledygook (SMOG; McLaughlin, 1969). For more details about the validity, reliability and development of these measures please see the introduction section.

The Suitability Assessment of Materials (SAM)

The suitability of the user guide was assessed using the Suitability Assessment of Materials (SAM; Doak et al., 1996). The SAM was used to assess both the content and design of the OG and RG. The SAM offers a quick and systematic method of assessing the suitability of a written health material for a particular population. There are six areas of written materials that SAM assesses. They are: content, literacy demand, graphics, layout and typography, learning stimulation and motivation, and cultural appropriateness. Each area can be assigned a rating and points that correspond to that rating. These ratings are shown in table two.

Two PhD-level audiologists conducted the SAM evaluation. One has 15 years of clinical and academic experience working with adults with hearing loss, and the other had 11 years of experience. Both researchers have had previous experience using the SAM to evaluate audiology consumer material. Each researcher reviewed the SAM materials provided by Doak et al. (1996). Each researcher independently evaluated two hearing aid user guides that were not part of the study material and discussed any discrepancies in scores. Finally, they independently evaluated the OG to derive a SAM score. Following revision of the user guide, the same two researchers applied the same procedure to evaluate the RG.

The SAM was applied to the RG in the following ways:

Aspect of SAM	Examples of ways this aspect of SAM was used in the RG
A. Content	- The purpose was clearly stated on the cover page - Instructions were worded to indicate what behaviour was required to care for hearing aids - The scope was limited to what was required for the specific aids being use - A summary was included
B. Literacy demands	- Reading level grade complied with recommendations for health materials - The active voice was used in all re-written sections - Common words were used where possible - Headings were used to break up the information into manageable chunks
C. Graphics	- Cover image included the specific hearing aid model of the guide - Simple line drawing was used where images were required - Lists and tables were used to organise information - Explanatory captions accompanied graphics

D. Layout and typography	- Use of white space to reduce clutter - Black writing on white paper for high contrast and easy visibility - Large type size - Common, clear font	
E. Learning stimulation and motivation	- Behavioural modelling used in DVD - Complex tasks were divided into smaller chunks so they appear more doable	
F. Cultural appropriateness	- Logic, language and experience of the New Zealand population was taken into account	

Consumer acceptability

In a prior study (Russell, 2015), the acceptability of the OG was assessed using the process described by Doak et al. (1996). As reported by Russell (2015), consumers (adults with HI) were interviewed individually using a structured interview template. The interview assessed four aspects of the user guide. First, the attraction of the user guide was assessed. For example, participants were asked if the visuals were interesting, if the tone was engaging, and if the colours were appropriate. Second, comprehension of the material in the guide was assessed. Participants were asked if the guide used unfamiliar words, if any instructions were difficult to follow, and additional visual were needed. Participants were also asked direct comprehension questions such as what size battery the hearing aid required and how to turn the hearing aid on and off.

The third topic assessed was SE. Participants were asked how confident they were that they could use the hearing aid after reading the user guide and if additional information was needed. Finally, participants were asked about the cultural appropriateness of the user guide. Specifically, they were asked if anything in the guide could cause offense or if any parts of the guide felt disingenuous.

Revision process

Information from the readability and suitability assessments and from the consumer interviews were used to revise the hearing aid user guide. The international consensus is that health education materials should be written at or below the sixth RGL (e.g., Doak et al., 1996; Friedman & Hoffman-Goetz, 2006; National Institutes of Health, 2013; Safeer & Keenan, 2005). To ensure the revised user guide met this international recommendation, the same readability formulas were used to calculate the readability during the revision process. The readability formulas FRE, F-K grade level and SMOG were used to analyse the readability of the revised user guide. The user guide was revised until it met the RGL recommended for health materials. The text in the legal information section was not altered during the revision due to possible legal implications.

The SAM was used to revise the guide until it had a SAM score within the "adequate" (> 40%) or "superior" (< 70%) range. In addition to the guidelines from Doak et al., (1996), recommendations from other authors were used in the revision. Table seven summarises these revisions. A sample of sections of the revised guide are displayed in appendix G.

Table 7

Recommended Written Healthcare Materials Revisions

Article	Suggestions	Revisions made
Caposseco, Hickson, and Meyer (2014)	Use a font size of at least 12 pts.	Font size 16 pts. was used
	Reading level at 3rd to 6th grade level	Overall grade level was 5.0 using FRE readability formula
	Organise information in a logical way	Sections and chunking were used
Hill-Briggs, Schumann, and Dike (2012)	Keep sentence length below 15 words	Short sentences were used
	Minimise frequency of jargon	Jargon was minimised an explained where necessary
	Use simple sentence construction	Simple sentences were used where possible
Caposseco, Hickson, and Meyer (2011)	Using personal pronouns in order to engage the reader	In the revised guide the aids are referred to as 'your aids' where appropriate
	Include a summary	A summary was added to the revised guide
	Do not include information that is not relevant to the user	The user guide only contained the information that was relevant to the hearing aid settings
	Use bold font to emphasis important words rather than italics or underlining	In the revised user guide key words were highlighted in bold
Hoffmann and Worrall (2004)	Use simple line drawings where necessary	A line drawing of the aids was used
	Write in second person not first person	'You' was used instead of 'user'
	Use a letter colour that contrasts well with the back ground	Black ink on white paper was used
	Use short words and sentences	This was done where possible and a glossary explained necessary long words
D'Alessandro et al. (2001)	Use active instead of passive voice	The revised guide was reduced to 0.5 % passive sentences.
	Include a glossary for important words	A glossary was included in the revision

In addition to revising the user guide, a video was also made to accompany the revised user guide. This was to increase SE by modelling (Bandura, 1978a, 1978b) and because a visual example is recommended for improving memory of tasks (Brooke, 2012). The video was created using a digital Sony Exmor R HDR-CX110 camera mounted on a tripod. All tasks were completed with black cloth background to provide contrast and make them easier to see. The tasks were filmed from the point-of-view of a hearing aid user; how they would see and interact with the hearing aids in order to minimise confusion. Editing of the video was done using Windows Movie Maker, iMovie, and iDVD. The video was divided into chapters that corresponded to chapters in the RG. The participant could select these chapters individually. No audio was included because potential hearing aid users may not be able to hear it clearly. Large title text and captions in a contrasting colour to the image were included. This text had the same wording as was written in the RG. Screen shots of the user guide titles and demonstrations are presented in figures one and two.

Figure 1. Example of a section title from the revised user guide video.

Figure 2. Example of a demonstration from the revised user guide video.

When there was a task to complete in the user guide, a demonstration was provided in the video. The researcher was videoed completing the task following the instructions in the guide. The tasks were in the same order and had the same title as the written guide. Captions were used to describe the tasks, using the same wording as in the guide. The text was large and high-contrast. A video symbol in the RG indicated there was a video to go with that section.

Part Two: Evaluation of Revised Guide

Ethical considerations

Ethical approval from the Human Ethics Committee of the University of Canterbury was sought and granted on the 6th of May 2015 (Appendix A). A poster revision was approved on the 18th of May 2015 (Appendix B). Consent was obtained from each participant as described in the procedures section (Appendix C).

A priori analysis

In order to determine the required sample size, *a priori* calculation was done prior to recruiting participants. The calculation was performed considering a statistical power of 0.8

and a significance level of .05. The *a priori* calculation indicated that a total of 40 participants, 20 in each group, would be required to reach this level of power and effect size of $d = .75$.

Participants

Participants were identified and recruited by placing advertising posters placed in public areas around Christchurch including supermarkets, libraries and churches. These posters were displayed for seven months during 2015. The study was also publicised by word-of-mouth. The first people to respond to the advertisement and meet the inclusion criteria were included, until required numbers were reached. It was estimated 40 participants would be required in total based on study design (Convery, 2013) and previous research. A total of 43 people responded. Thirty-one of those met the inclusion criteria and were eligible to take part in the study. Sixteen participants were quasi-randomly assigned to the group who used the OG. One participant did not complete all stages of the data collection so their data was excluded. Fifteen participants were quasi-randomly assigned to the group who used the RG. This was achieved using a random number generator. When each participant was recruited a zero or a one was generated. If a zero was generated, the participant was assigned to the OG group and if a one was generated they were assigned to the RG group. Toward the end of the recruitment period participants were assigned to groups to ensure equal group size.

Participants were excluded if they reported current ear infections or pain in their ears. Participants were eligible to participate in the study if:

a) They had a HI
b) They had no previous hearing aid experience
c) They were at least 18 years of age
d) They displayed no contra-indications to hearing aid fitting such as discharging ears.

Materials and Procedures

Participants responded to advertising posters or heard about the study via word-of-mouth. They expressed an interest either via telephone or email. If they met the inclusion criteria, participants were sent a pack that contained (a) the information sheet, (b) consent form, (c) demographic questionnaire, (d) Hearing Handicap Questionnaire (HHQ) and (e) Levenson scales. This was done either via email or post depending on their preference. After verifying receipt of the pack, all participants were scheduled for a data collection session at the University of Canterbury. The participants were blinded to their group membership until the end of the study.

The demographic questionnaire (Appendix D) contained information about the participants: age, gender, working status, income level, education level, length of HI, and relationship status. The Hearing Handicap Questionnaire (HHQ; Gatehouse & Noble, 2004) is a 12-question standardised self-assessment tool that was used to obtain information about degree of hearing handicap. It was developed as part of the Speech, Spatial, and Qualities of Hearing Scale and derived from items in the Hearing Disabilities and Handicaps Scale (Hétu, Getty, Philibert, Noble, & Stephens, 1994) and the Glasglow Health Status Inventory (Robinson, Gatehouse, & Browning, 1996). The HHQ is scored with one point given for each 'never' response, two for 'rarely', three for sometimes', four for 'often' and five for 'almost always'. The sum of all responses is the total score for that participant. Scores range from 12 to 60 with 12 being no hearing related handicap and 60 being a severe hearing handicap.

Levenson Locus of Control (LoC) scales (Levenson, 1973, 1974) were used to assess source of LoC. There are three scales: Internal LoC, Powerful Others and Chance. Different questions relate to different subscales and each are added to give three final scores. Levenson (1973) used factor analysis to indicate validity for separating out the Internal, Powerful Others and Chance subscales. (Levenson 1974).

The data collection was conducted in a clinic room at the University of Canterbury that had been prepared with the necessary equipment for completing audiometric testing and the hearing aid tasks. The participants received a hearing check to verify and quantify HI. At this appointment the participants were also asked about their hearing to determine if there were any contraindications to hearing aid fitting. Otoscopy was performed using a Welch Allyn MacroView otoscope to establish if the testing could be carried out safely.

Air conduction pure-tone thresholds were obtained in a sound treated room meeting the International Organisation for Standardisation standards for audiometric testing (ISO, 2010). The researcher measured air conduction thresholds using either a Grason-Stadler 61 two-channel audiometer or Equinox computer-based audiometer. The audiometers were both within calibration. The transducers were either EarTone A3 foam insert earphones or TDB 39P supra-aural headphones. The researcher followed the modified Hughson Westlake procedure (Carhart & Jerger, 1959). Two ascending responses at the same intensity were considered a threshold. The participants used a push button response. Frequencies measured were: 500, 1000, 2000 and 4000 Hz in order to obtain the four-frequency average (4FA), which was used to define the hearing loss (Hickson et al., 2014, Meyer et al., 2014, Convery, 2013). This method was used because, unlike a typical three frequency pure-tone average, it includes additional information at 4000 Hz. A 4FA of poorer than 20 dBHL was considered necessary for inclusion in this study. Masking using the plateau method was performed if it was necessary. For participants who had further concerns about their hearing or who had a previously undiagnosed hearing loss, a full diagnostic audiological assessment was recommended.

Those participants who met the hearing loss criteria were then given as much time as they required to familiarise themselves with the hearing aid user guide (OG or RG) and hearing aids. The Oticon Alta hearing aids were programmed for a mild high frequency hearing loss. The program buttons were set up to control the volume because this would be an appropriate setting for a new user. The wire length used was size two unless the participant had exceptionally small or large features. The receiver power was 85. The dome was open, the colour of the hearing aid was silver and the battery size was 312. Participants were provided with the accessories necessary to complete the Utility tasks. These included: a MultiTool, a cloth, size 312 batteries, a packet of domes, and filters in the size appropriate for the hearing aids.

The original colour Oticon Alta user guide that accompanied the hearing aids was provided for the participants in the OG group. A printed A4-sized colour copy of the revised user guide and accompanying DVD were provided for the participants in the RG group. A desktop computer with Philips monitor was used to play the DVD. The software program used was Windows Media Player. The participants controlled this as they wished, using the mouse. During the familiarisation time, the participants could practise with a set of hearing aids and the user guide (OG or RG) to which they were assigned. They had as much time as they required to familiarise themselves with the user guide and hearing aids. The researcher recorded how long each participant spent on the familiarisation task.

SE was assessed using the Basic Handling Subscale (BHS) and Advanced Handling Subscale (AHS) of the Measure of Audiologic Rehabilitation Self-efficacy for Hearing Aids questionnaire (MARS-HA; West & Smith, 2007). This questionnaire was administered immediately following the familiarisation task in order to account for the possible impact of the Utility testing on the perception of SE. Participants were asked to circle a percentage from 0% to 100% based on how certain they were that they could do each task, as described previously. The MARS-HA was scored by taking the mean of the percentages circled by the participant for the BHS and AHS. The BHS consisted of items one to seven and the AHS consisted of items eight to twelve. The internal consistency of the subscales that are used for this project were a Cronbach's alpha of 0.86 and 0.81 for the BHS and AHS respectively. It was found that test-retest reliability was $\lambda = 0.92$ for the entire scale. It was also validated against the Hearing Handicap Inventory for the Elderly (HHIE). Results indicated the MARS-HA is an independent measure of HA-SE as they were not loaded on the same factor.

After completing the MARS-HA, Utility testing was carried out. Participants were asked to perform tasks by following the instructions in the user guide and using the materials provided. Participants could refer to the user guide if they wished during the Utility testing. Tasks included cleaning and maintaining the hearing aids. The order of the tasks was not the same as the order in the instruction booklet. The tasks were broken down into steps. A score was given for each aspect of the task and a final score. Time taken to perform tasks was also recorded. Participants were asked to complete a series of tasks related to the use and maintenance of the hearing aids which are described below in table eight. The specific tasks and scoring schedule are displayed in Appendix F. Counselling was kept to a minimum during the data collection appointment to reduce confounding variables (Smith & West, 2006). However, after data collection was completed participants were free to ask questions.

Table 8

Utility Testing Hearing Aid Tasks

1. Insert hearing aid	2. Remove hearing aid
3. Clean hearing aid	4. Increase volume
5. Decrease volume	6. Replace the battery
7. Replace the dome	8. Replace the filter
9. Turn hearing aid off	10. Turn hearing aid on

During Utility testing, participants' responses were video recorded in order to be analysed by a third researcher who was blinded to group allocation. The video equipment included a 32 GB Sony memory card and Sony Exmor R HDR-CX110 digital video camera on a tripod. Reliability of scoring was accomplished by using pilot testing scoring, measuring inter-rater reliability and having the same researcher score each participant.

Pilot testing was performed to improve the scoring system and identify potential problems. During the pilot testing the tasks and methods were refined. Three volunteers completed the Utility tasks as part of the pilot testing. After each volunteer revisions were made to the Utility tasks. Revisions were made to the scoring method in order to make it clear and applicable to different participants.

Scoring followed the precedent provided by Brooke et al. (2012). The tasks were divided up into steps. For example, for the task 'increase volume' the steps were:

1. Press the volume button

2. On the *right* aid.

The scoring system was applied in the following way:

One point was awarded if:

- the step was completed correctly.

Zero points were awarded if:

- the step was completed incorrectly,
- the step was not completed or
- if assistance from the researcher was required.

The total score was out of a total of 30 possible marks. Please see appendix E for details of the Utility scoring matrix.

As participants were required to travel to the University of Canterbury, compensation of a $10 petrol voucher for the data collection session was offered. Infection control procedures were completed after each participant. These included disinfecting the aids, care tools and audiometric equipment. The researcher also sanitised her hands between participants.

Research Design

This study used a double blinded, randomised control design. The independent variable was the version of the user guide (OG or RG). In Part One the dependent variables were readability and suitability. In Part Two the dependent variables were SE and the Utility test.

Statistical Analyses

All analyses were completed using IBM Statistics Program for Social Sciences (SPSS) Version 22 (2013). Due to lack of normality, non-parametric testing was used. Chi Square tests were used to compare the groups for the study predictor variables. Potential covariates were identified by performing Spearman correlational analysis between the demographic, audiometric or self-report variables and the measures of SE. If significant correlations were found, a partial correlation was used to control for the possible effects of those variables and determine the effect of the revision on SE. Clinical significance and effect size were considered.

Chapter Three: Results

Overview

For Part One of this study the readability and suitability of an original and a revised hearing aid user guide were analysed. The original guide (OG) was not within the recommended readability or suitability guidelines for healthcare materials. The revised guide (RG) was within the recommended guideline for written health materials and considerably improved in comparison to the OG. For Part Two of this study non-parametric testing was used to assess the hearing aid self-efficacy (HA-SE) of the participant groups using the OG and RG. Overall, the RG group had higher scores on the Measure of Audiological Rehabilitation Self-efficacy for Hearing Aids (MARS-HA) than the OG group. The differences in self-efficacy (SE) were significant and had medium-to-large observed effect sizes (Cohen, 1988). Utility testing results indicated a statistically significant relationship between user guide version and Utility scores. There was also a large effect size for this relationship (Cohen, 1988).

Part One: Results of Revision

Readability

It was predicted the RG would have lower readability scores on the SMOG and F-K readability formulas and a higher score on the FRE than the OG. Readability scores indicated improved readability across all three measures as presented in table nine.

Table 9

Readability Statistics for Original and Revised User Guides

Readability measure	Original Guide	Revised Guide
F-K (RGL)	11.4	5.0
FRE (0-100)	42.2	75.8
SMOG (RGL)	13	6

Note: Abbreviations F-K = Flesch Kincaid, FRE = Flesch Readability Formula, SMOG = Simple Measure of Gobbledygook, RGL = Reading Grade Level

The average of the F-K and SMOG for both the OG and RG was taken to give an overall readability score. These averages are displayed in figure three. The FRE formula was not included as it is not scored in reading grade level. In addition, the FRE score of the OG was 42.2 indicating it was "difficult to read". The RG scored 75.8 on the FRE indicating it was "fairly easy to read" (Flesch, 1948).

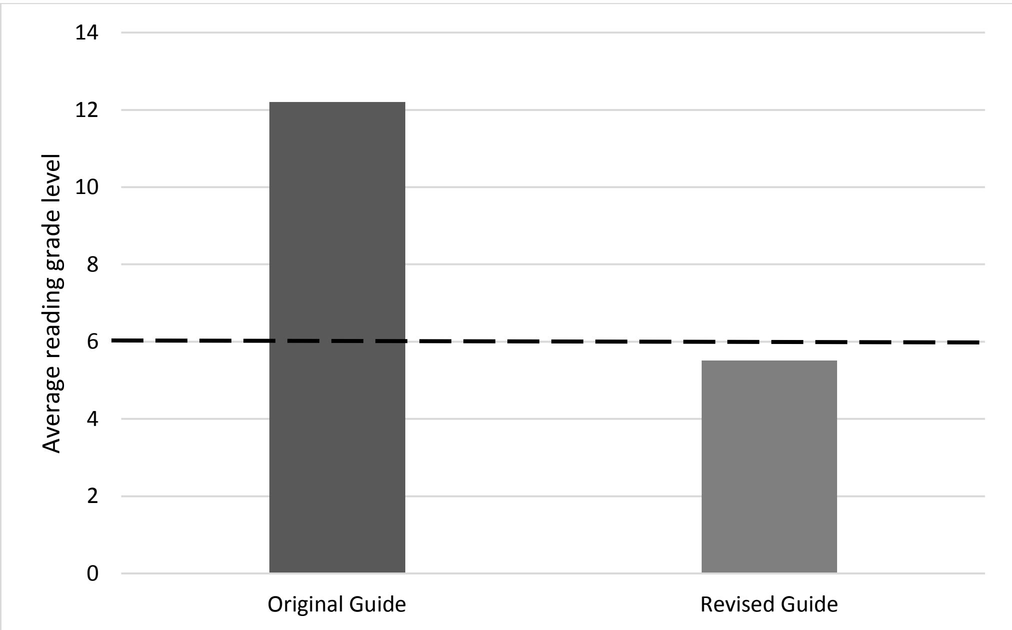

Figure 3. Average readability in reading grade level of F-K and SMOG readability formulas. Recommended readability for health materials is indicated by the dashed line.

Suitability Assessment of Materials (SAM)

Inter-rater reliability for SAM

Reliability between scorers was found to be excellent (Fleiss, 1981) using Intraclass Correlation Coefficients (ICC). The ICC was .976, p <.001 and average measure was 9.88, p <.001. The average of values from scorer one and scorer two were used for analysis.

SAM scores

It was expected the RG would score more highly on the SAM than the OG. The RG was also expected to score in the 'adequate' (> 40%) or 'superior' (> 70%) range. This prediction was supported by the data presented in table ten.

Table 10

SAM Rating for Original and Revised User Guides

User guide version	Scorer One (%)	Scorer Two (%)	SAM rating
Original guide	31.58	26.32	Not suitable
Revised guide	81.58	76.31	Superior

A large improvement in SAM score between the OG and RG was found when the two scorers' results were averaged. The magnitude of this improvement is demonstrated in figure four.

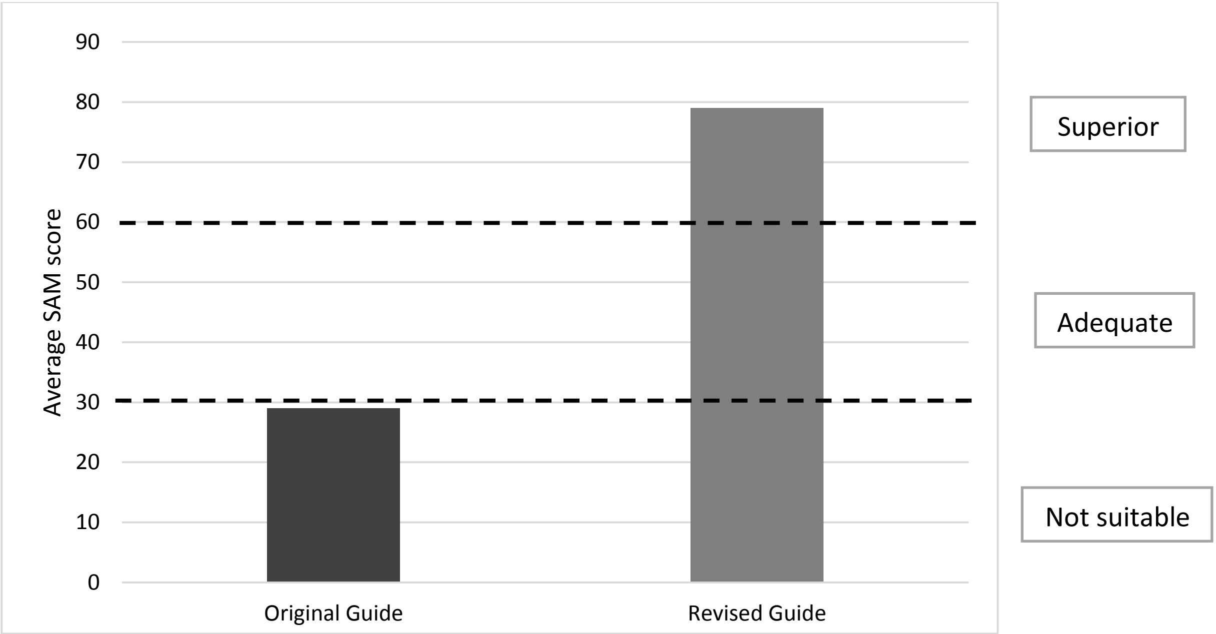

Figure 4. Average of two scorers' SAM results for Original Guide (OG) and Revised Guide (RG) in percent. The dashed lines indicate the values for "not suitable", "adequate" and "superior" SAM scores.

Part Two: Self-efficacy Analysis and Validation of User Guide

Sample characteristics

Demographic factors

Forty-three people expressed an interest in taking part in the study in response to recruitment efforts. Thirty-one of those met the inclusion criteria and were able to attend a testing session. Of those participants who attended a session one did not complete all the tasks. Therefore, 30 participants were included in the final data set. Fifteen used the OG and 15 used the RG. Calculations were completed using Statistic Program for Social Sciences (SPSS).

The sample was analysed for normality using skewness and kurtosis values. A Z-test was used to assess normality. This was done by comparing the skewness and kurtosis values divided by their standard error to the critical value of 1.96 (Kim, 2013). Kurtosis was not normal for age, worse ear pure-tone average, better ear pure-tone average and Internal Locus of Control (LoC). Skewness was not normal for worse ear pure-tone average, better ear pure-tone average and Internal LoC. Box plots indicated outliers for some variables but none were statistically significant. Therefore, non-parametric testing was used.

Participants were assigned to groups quasi-randomly using a random number generator and manual allocation for even group size. The OG and RG groups were not expected to be significantly different on the control variables consisting of demographic factors, audiological factors or Levenson scale scores.

Chi Square and Man-Whitney-U test calculations were used to test independence of the groups. Because of the small sample size, not all categories had sufficient data points for the Chi square to be completed. Categories that were collapsed to allow for analysis were relationship status (in a relationship (yes) or not in a relationship (no)), household income ($0 - $50,000, $51,000 - $100, 000 and more than $100,000) and educational level (high school (HS), undergraduate (UG) and postgraduate (PG)). Most demographic factors did not display a significant difference between groups. However, there was a significant difference between the OG and RG groups for the workers or non-workers categories. The demographic statistics are displayed in table eleven.

Table 11

Participant Demographic Characteristics and Test for Significant Difference Between Groups

	Original Guide Group (n = 15)	Revised Guide Group (n = 15)	U or X^2	df	*p*
Male	6	8	.536	1	.715
Female	9	7			
Age	Mean = 61.2	Mean = 60.0	109.5	1	.910
	SD = 18.5	SD = 18.1			
Ethnicity	NZE = 14	NZE = 14	.000	1	1.000
	Canadian = 1	Canadian = 1			
Relationship	Yes = 8	Yes = 12	2.60	1	.109
	No = 7	No = 3			
Income	\$0-50k = 8	\$0-50k = 4	2.33	2	.477
	\$51-100k = 6	\$51-100k = 10			
	>100k = 1	>100k = 1			
Education	HS = 4	HS = 0	4.62	2	.169
	UG = 8	UG = 11			
	PG = 3	PG = 4			
Working	Yes = 3	Yes = 10	6.65	1	.025
	No = 12	No = 5			

Note: Abbreviations SD = standard deviation, NZE = New Zealand European, HS = High School, UG = Undergraduate and PG = Postgraduate.

The relationship between working status and HA-SE was assessed to determine if the statistically significant difference between the groups in working status would need to be controlled for when calculating the HA-SE results. There was not a significant correlation between work status and MARS-HA subscales using the Mann-Whitney U test (BHS U = 95, p = .628 two tailed, AHS U = 100, p = .672 two tailed). Therefore, it was not necessary to control for working status when comparing HA-SE between the groups.

Audiological factors

Due to quasi- random assignment to groups the OG and RG groups were not expected to be significantly different in audiological factors. As predicted, the groups were not significantly different on audiological factors as presented in table twelve. This was tested using a Mann-Whitney U test.

Table 12

Audiological Scores or Original and Revised User Guide Groups and Test for Significant Differences Between Groups

Audiological measure	Original User Guide Mean (SD)	Revised User Guide Mean (SD)	U	*p*
Hearing severity	4.8 (2.9)	4.4 (2.5)	105.0	.828
HHQ	26.8 (9.4)	24.0 (7.5)	96.5	.570
BEPTA	26.3 (11.1)	32.2 (21.4)	105.0	.828
WEPTA	37.0 (12.1)	50.3 (33.2)	96.5	.570

Note: HHQ = Hearing Handicap Questionnaire, BEPTA = Better Ear Pure-tone Average, WEPTA = Worse Ear Pure-tone Average, SD = Standard Deviation.

Hearing aid funding status

The OG and RG groups were not significantly different in hearing aid funding status. Both groups contained one participant who had applied for a government hearing aid subsidy. No one from either group was aware of being eligible for other hearing aid funding. This was in agreement with the prediction that the two groups would not be significantly different in hearing aid funding status.

Levenson scales

It was predicted that the OG and RG groups would not be significantly different on any of the Levenson scales. This was calculated using a Mann-Whitney U test. As there was no significant relationship between Chance and MARS-HA scores it was not necessary to control for this difference between the groups in HA-SE analysis. As shown in table thirteen, scores on the Internal LoC scale and Powerful Others scale were not significantly different between the groups. However, the groups were significantly different in their Chance scale scores. The effect size was large (Cohen's d = .80).

Table 13

Levenson Subscale Scores and Test for Significant Differences Between Groups

Levenson subscales	Original Guide Group Mean (SD)	Revised Guide Group Mean (SD)	SD	U	*P*	*p*
Internal Locus of Control	35.9 (5.6)	36.8 (7.6)	6.7	92.0	<.50	.405
Powerful Others	21.2 (11.3)	16.2 (8.9)	10.3	76.0	<.50	.133
Chance	19.9 (9.1)	12.5 (9.5)	9.9	61.0	.85	.032

Self-efficacy

Levenson scales and the MARS-HA

It was predicted that there would be a relationship between Levenson scale and MARS-HA. All correlations were small and most were not statistically significant. Specific predictions were as follows.

As Basic Handling subscale (BHS) scores on the MARS-HA increase:

- The Internal LoC scale scores would increase

- The Powerful Others scale scores would decrease
- The Chance Scales would decrease

As Advanced Handling subscale (AHS) scores on the MARS-HA increase:

- The Internal LoC scale scores would increase
- The Powerful Others scale scores would decrease
- The Chance scales would decrease

This was tested using Spearman correlations and 1-tailed significance as predictions were directional as is shown in table fourteen. The only correlation that reached statistical significant was the relationship between the AHS of the MARS-HA and the Internal LoC Levenson scale.

Table 14

Relationships Between Levenson Subscales and MARS-HA Scores

MARS-HA subscale	Internal Locus of Control	Powerful Others	Chance
Basic Handling	r_s = .213	r_s = -.208	r_s = -.020
	p = .107	p = .135	p = .459
Advanced Handling	r_s = .463	r_s = -.174	r_s = -.028
	p = .005	p = .179	p = .441

Note: Abbreviation MARS-HA = Measure of Audiologic Rehabilitation Self-efficacy for Hearing Aids

Familiarisation time and the MARS-HA

It was expected there would be no significant relationship between familiarisation time and MARS-HA. A Spearman correlation analysis supported this hypothesis. For the BHS (r_s = -.016, p = .931,) as seen in figure five.

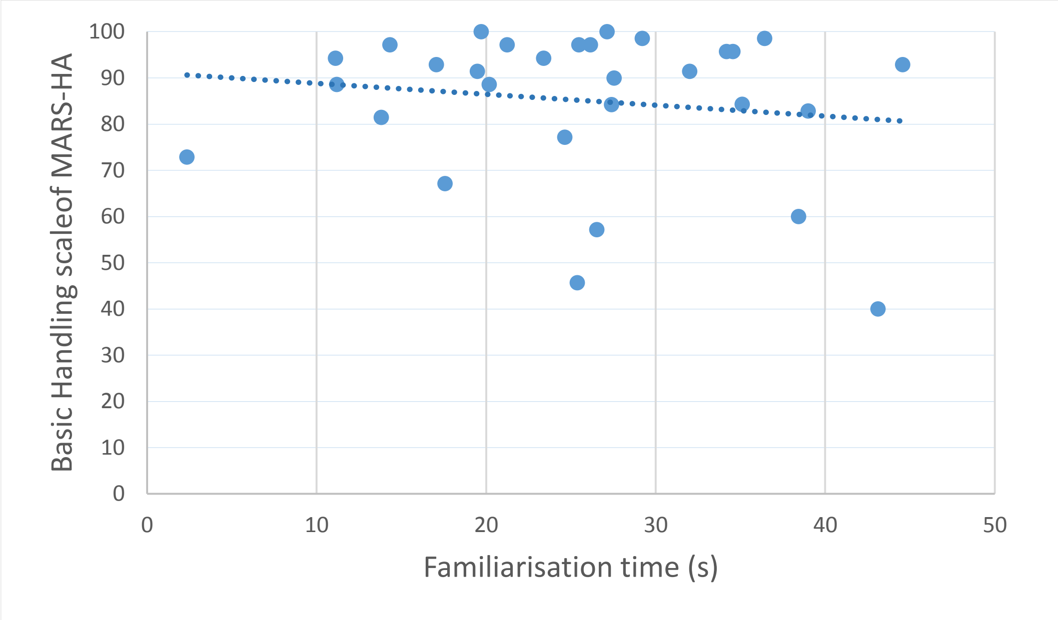

Figure 5. Negative and statistically non-significant relationship between familiarisation time and score on the Basic Handling MARS-HA subscale.

As predicted, there was not a significant relationship between familiarisation time and the AHS of the MARS-HA (r_s =-.218, p = .247,) as demonstrated in figure six.

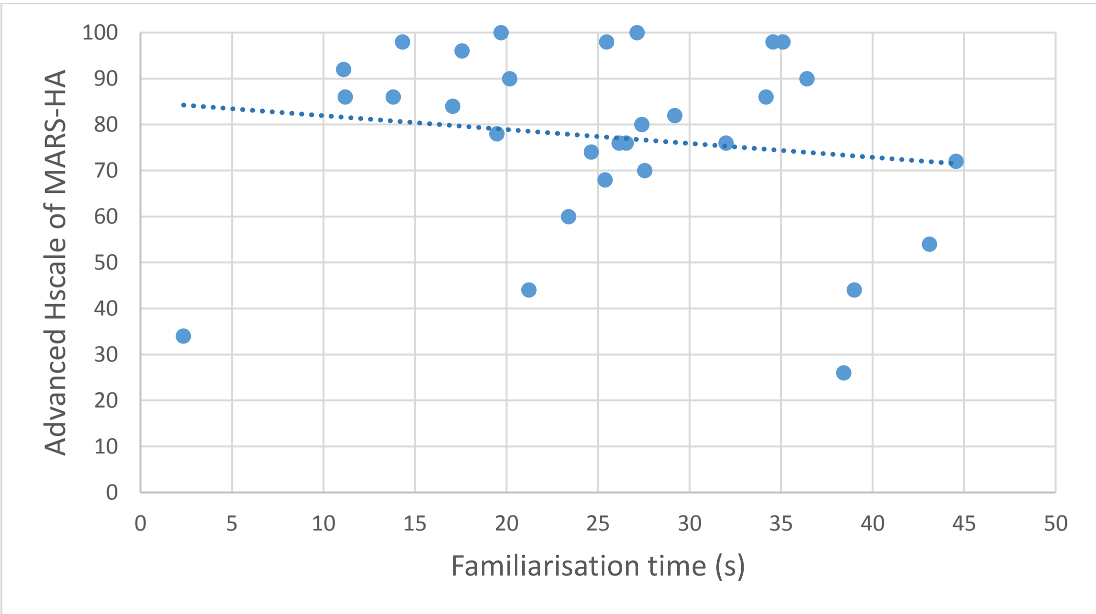

Figure 6. Small, negative and not statistically significant relationship between MARS-HA Advanced Handling subscale and familiarisation time.

MARS-HA hypothesis testing

It was expected that scores on both the BHS and AHS of the MARS-HA would be significantly higher in the RG group compared to the OG group. This hypothesis was supported for both the BHS and AHS of the MARS-HA.

Group differences on the BHS of the MARS-HA were analysed using a Mann-Whitney U non-parametric test. The groups were significantly different from each other, which supports the hypothesis. The Cohen's *d* effect size was large (Cohen, 1988). These results and the 95% confidence intervals for both the OG and RG groups are seen in table fifteen.

Table 15

MARS-HA Basic Handling Subscale Averages and Test for Significant Difference

User guide group	Mean	95% CI	SD	U	1- β	*p*	*d*
Original	78.7	67.6 - 89.7	20.0	71.5	.85	.008	.858
Revised	91.6	87.6 - 95.6	7.2				

Note: 95% CI = Confidence Interval around the mean, SD = Standard Deviation, d = Cohen's *d* effect size.

A high MARS-HA score indicates high HA-SE and a low MARS-HA score indicates low HA-SE. The RG group had a higher average HA-SE score than the OG group. There was also more variation between scores in the group using the OG.

AHS of MARS-HA:

The AHS of the MARS-HA was also analysed using a Mann-Whitney U non-parametric test. The groups were significantly different from each other and the group using the RG scored more highly than the group using the OG. This supports the prediction that HA-SE would be higher for the group using the RG. Effect size of the difference between the

OG and RG groups for the BHS of the MARS-HA was calculated using Cohen's *d* and found to be large. These results are displayed in table sixteen with the 95% Confidence Interval for both the OG and RG groups.

Table 16

MARS-HA Advanced Handling Subscale Averages and Test for Significant Difference

User guide group	Mean	95% CI	SD	U	1- β	*p*	*d*
Original	70.3	59.4 - 81.0	19.5	55.5	.77	.045	.722
Revised	84.1	73.8 - 94.5	18.7				

Note: 95% CI = Confidence Interval around the mean, SD = Standard Deviation, d = Cohen's *d* effect size.

Percentage of participants with "adequate" hearing aid self-efficacy

A score of 80% or greater on the MARS-HA was considered 'adequate' HA-SE (Smith & West, 2006; Meyer, Hickson, & Fletcher, 2014). The percentage of participants in both the group using the OG and the group using the RG were compared for the BHS and AHS of the MARS-HA.

The percentage of participants with HA-SE in the adequate range, or over 80%, for the BHS of the MARS-HA was greater for the RG group than the OG group as shown in figure seven. The groups were significantly different for adequate HA-SE on the BHS of the MARS-HA when analysed for significance using a Chi-square (U = 75.0, *p* = .034).

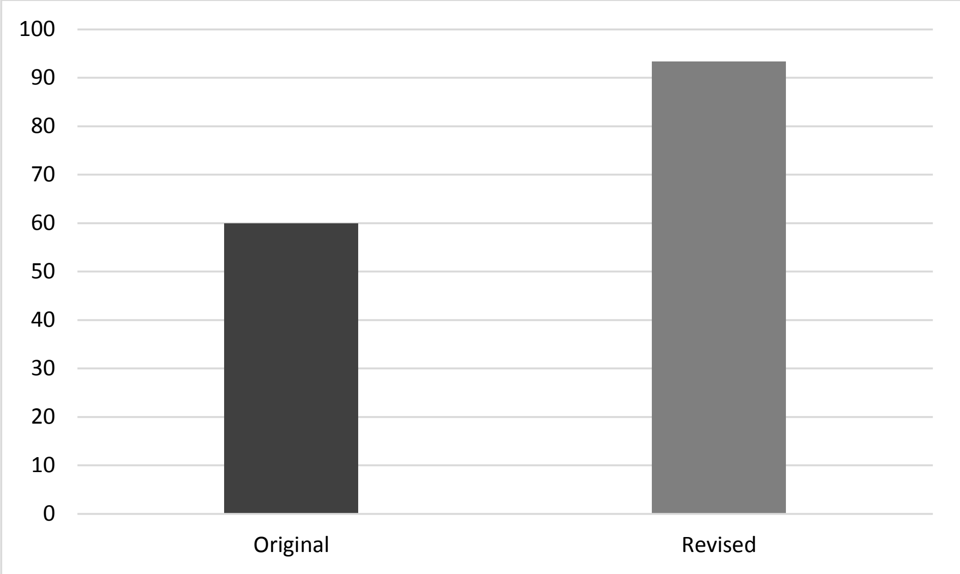

Figure 7. Percentage of group with “adequate” scores on the Basic Handing subscale of the MARS-HA.

The percentage of participants with HA-SE in the adequate range, or over 80%, for the AHS of the MARS-HA was greater for the RG than the OG as shown in figure eight. Using a Chi-square test there was found to be a significant difference between those with adequate HA-SE for the AHS of the MARS-HA (U = 67.1, p = .031).

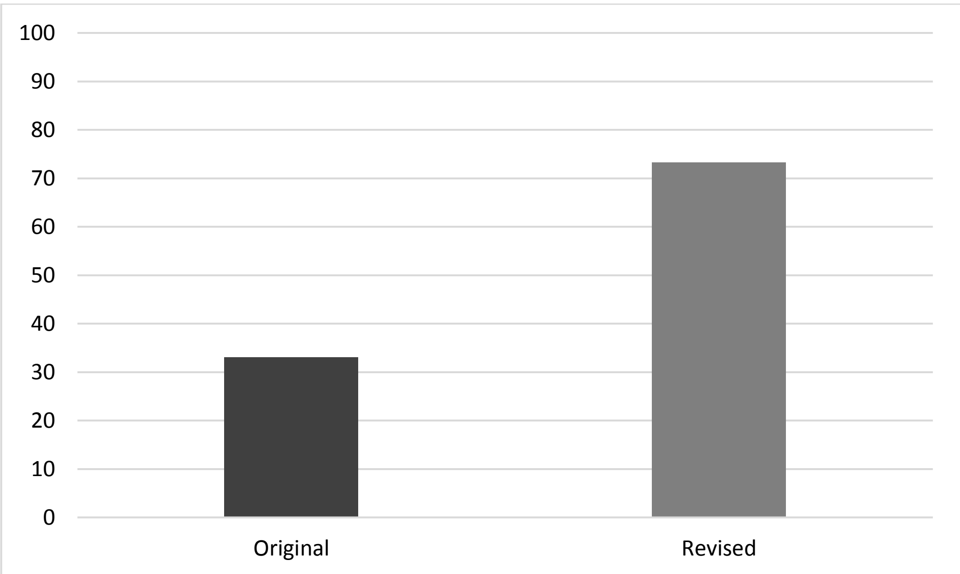

Figure 8. Percentage of group with “adequate” scores on the Advanced Handling subscale of the MARS-HA

Utility testing

Inter-rater reliability

Inter-rater reliability was found to be acceptable for the Utility scoring method. All calculated values are above the level Fleiss (1981) established for "excellent agreement beyond chance" (p. 218). For both OG and RG combined: ICC = .994 (95% CI: .973 - .999) for the OG group only: ICC = .987 (95% CI: .816 - .999) and for the RG only: ICC = .889 (95% CI: .715 - .993). The 'single measures' ICC was used.

Utility scores

As predicted, the Utility testing scores were significantly higher for the group using the RG than the group using the OG. Utility scores were calculated by taking the mean for each group. These values, the variation and Mann-Whitney-U test for significant difference between groups are displayed in table seventeen.

Table 17

Utility Testing Means and Test for Significant Difference Between Groups

User guide group	Mean	95% CI	SD	U	1- β	*p*	*d*
Original	18.7	15.9 - 21.9	5.5	42.0	>.85	.001	1.26
Revised	25.2	22.7 - 27.7	4.4				

Note: 95% CI = Confidence Interval around the mean, SD = Standard Deviation, d = Cohen's *d* effect size.

Utility testing and self-efficacy

Utility testing score and HA-SE were expected to be positively and significantly correlated for both the BHS and AHS of the MARS-HA.

The relationship between Utility score and BHS scores of the MARS-HA was calculated using Spearman's correlation. A positive and statistically significant correlation was found as predicted (r_s = .384, p = .036). This relationship is demonstrated in figure nine.

As $r_s^2 = .147$, this indicates that 14.7% of the variance in a person's Utility score can be accounted for by their score on the BHS of the MARS-HA.

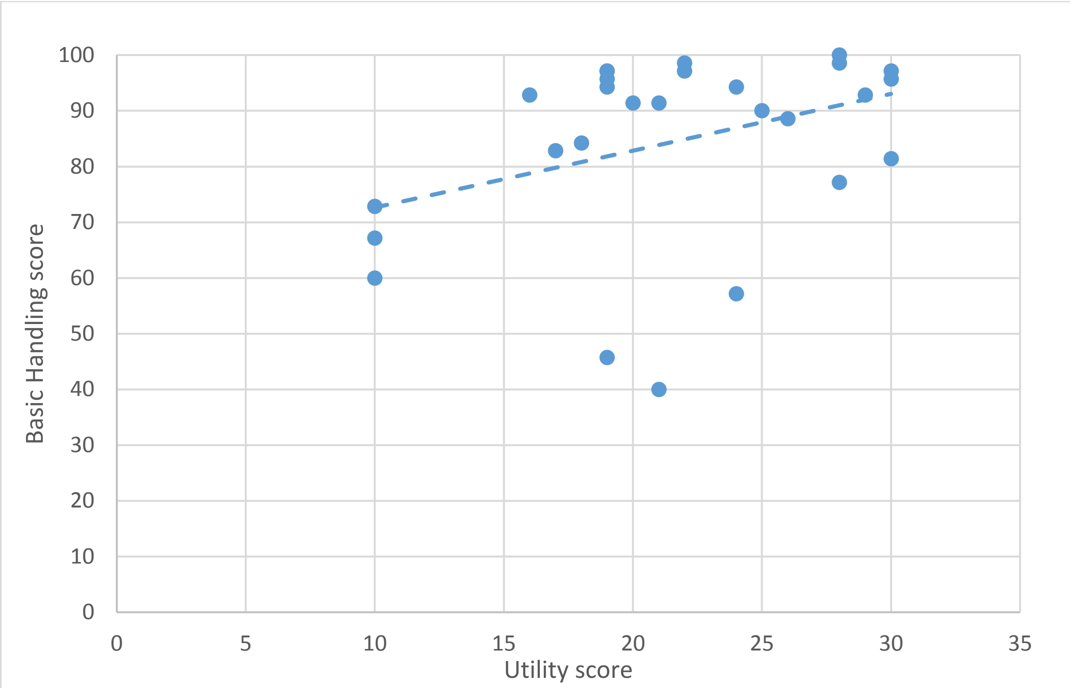

Figure 9. Relationship between Utility scores and Basic Handling subscale of the MARS-HA

It was predicted that as Utility scores increased scores on the AHS of the MARS-HA would also increase. As seen in figure ten, the data supported his prediction. A positive, statistically significant correlation between Utility scores and scores on the AHS of the MARS-HA ($r_s = .330$, $p = .038$) was found. In this case, $r_s^2 = .109$ indicating that 10.9% of the variance in a person's Utility score can be accounted for by their score on the AHS of the MARS-HA.

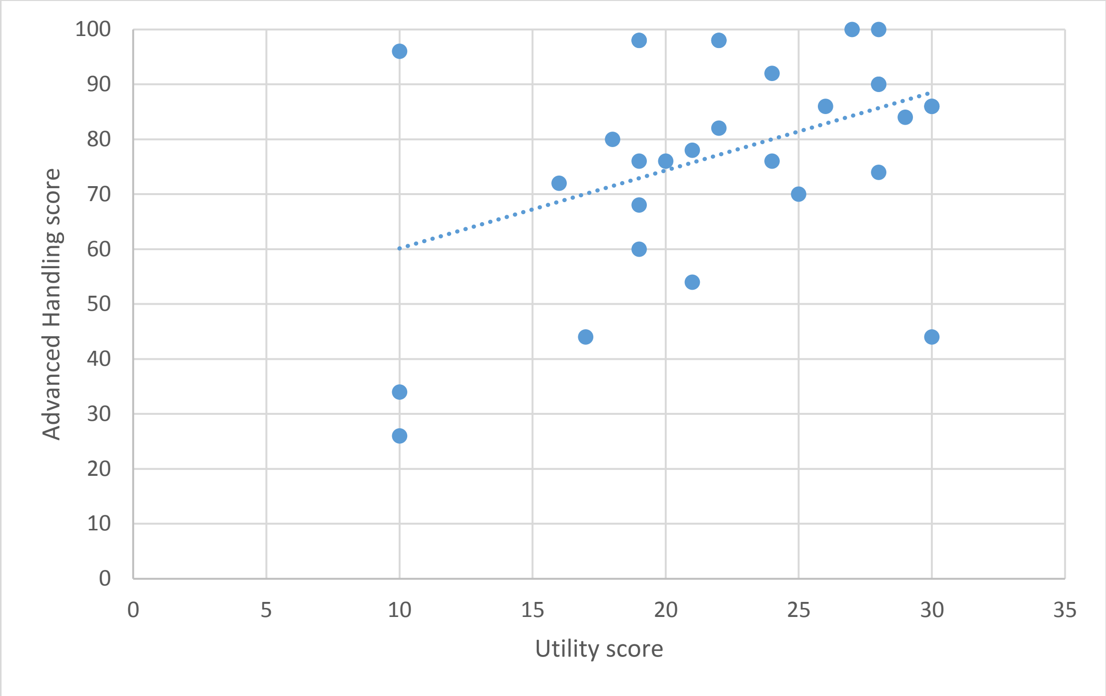

Figure 10. Relationship between Utility testing scores and the Advanced Handling subscale of the MARS-HA

Utility testing and familiarisation time

It was expected that there would be a positive relationship between utility test scores and familiarisation time. This was tested with Spearman's correlation. Contradictory to expectations, there was a weak negative relationship between Utility test scores and familiarisation time (r_s = -.219), however, it was not statistically significant (p = .123).

The only other measure that significantly correlated with Utility testing was age. This was a negative relationship (r_s = -.337, p = .034) which indicated that as age increase Utility scores decrease. This indicates that 11.4% of the variation in Utility testing scores could be accounted for by a person's age. A partial correlation was run to determine the relationship between HA-SE and Utility testing score while controlling for age. The results indicated there was still a statistically significant, positive relationship between HA-SE and Utility testing when controlling for the effects of age for both BHS and AHS of the MARS-HA (BHS r_p = .396, p = .017, AHS r_p = .484, p = .004).

Utility testing and Locus of Control

Spearman correlations were calculated to determine if there were any significant relationships between Levenson scales and Utility testing (see table eighteen). None were found.

Table 18

Relationships Between Utility Testing and Locus of Control

	Internal Loc	Powerful Others	Chance
Utility testing	r_s = -.203	r_s = -.022	r_s = -.130
	p = .274	p = .912	p = .494

Summary

Overall, the hypothesis that improving the readability and suitability of a hearing aid user guide can increase HA-SE was supported. This was indicated by superior performance in the group that used the RG in both the BHS and AHS of the MARS-HA. The relationship was tested using non-parametric methods as the data were not normally distributed. The groups were not significantly different on most control demographic and audiological factors. However, there was a significant difference between the groups in the Chance Levenson scale.

Other predictions were supported by the data. First, readability and suitability scores improved substantially with user guide revision. Second, a greater percentage of hearing aid users had ‘adequate’ HA-SE in the group using the RG than the group using the OG in both the BHS and AHS of the MARS-HA. Third, the group using the RG had significantly higher scores in the Utility testing than the group using the OG. Finally, MARS-HA scores were correlated positively with Utility testing scores.

There were also predictions that were not supported by the data. First, there was no significant relationship between any of the Levenson scales and MARS-HA scores. Second, there was no significant relationship between MARS-HA subscales and familiarisation time. Third, there was no significant correlation between Utility score and familiarisation time.

Chapter Four: Discussion

Summary of Findings

Introduction

This study examined whether improving the readability and suitability of a hearing aid user guide was associated with increased Hearing Aid Self-efficacy (HA-SE). The user guide was revised to the recommended sixth Reading Grade Level (RGL) for healthcare materials (Doak et al., 1996; Ley & Florio, 1996). In addition, the revised guide (RG) was in the “superior” range of the Suitability Assessment of Materials (SAM) (Doak et al., 1996). Participants were quasi-randomly allocated to the original guide (OG) or RG group. Both groups familiarised themselves with the hearing aids, completed the Basic Handling Subscale (BHS) and Advanced Handing Subscale (AHS) of the Measure of Audiologic Rehabilitation Self-efficacy for Hearing Aids (MARS-HA; West & Smith, 2006b) and performed Utility tasks with the hearing aids. The results supported the hypothesis that the readability and suitability of hearing aids user guides affects HA-SE. HA-SE was significantly higher in the group who used the RG than the group who used the OG. The effect sizes were moderate to large.

Significant findings

Part One: Revision of the user guide

The aim of the hearing aid user guide revision was to redesign the OG to conform to recommended written healthcare materials guidelines. Guidelines for producing and revising written healthcare materials were used, as were the readability formulas Flesch Reading Ease (FRE; Flesch, 1943), Flesch-Kincaid Grade Level (F-K; Kincaid et al., 1957) and Simple Measure of Gobbledygook (SMOG; McLaughlin, 1969) readability formulas and the SAM assessment of suitability. The readability scores of the RG were at or below the recommended sixth RGL. Overall, readability of the user guide was improved from an average RGL of 12.2 for the OG to an average RGL of 5.5 for the RG. In addition, the FRE score of the OG was 42.2 indicating it was “difficult to read” (Flesch, 1948). The RG scored 75.8 on the FRE indicating it was “fairly easy to read”. The suitability of the OG was also amended from “not suitable” for the OG to “superior” for the RG. As predicted, these scores indicate considerable improvement in both readability and suitability.

Part Two: Self-efficacy and Utility testing

HA-SE and Utility testing were carried out in order to determine if there were significant differences between the performance of groups using the OG and RG. Participants familiarised themselves with the user guide, hearing aids and video (for the RG). HA-SE was measured when the participants indicated they were familiar with the guide. HA-SE was measured using the BHS and AHS of the MARS-HA. The results supported the prediction that HA-SE would be greater for the group using the RG than the group using the OG.

After HA-SE had been measured, the Utility tasks were completed. This was done by asking the participants to complete ten tasks that had been described in the user guide. The hearing aids and maintenance items were provided. This section was video recorded in order for the scorer to be blinded to group allocation. Utility testing results supported the prediction that Utility scores would be significantly higher in the group using the RG (p = .001). There was a large effect size for the difference between the groups (Cohen’s d = 1.26).

Relation to the Literature

Part One: Revision of the user guide

The readability and suitability score of the OG was above the recommended sixth RGL. This finding is consistent with previous research that has indicated written healthcare materials, including audiology, to be at a higher readability level than recommended (e.g. Atcherson et al., 2011; Caposecco et al., 2014; Kirsch, Jungeblut, Jenkins, & Kolstad, 2002; Neuhauser et al., 2013; Safeer & Keenan, 2005).

As predicted, readability and suitability were improved for the RG. The RG also conformed to recommendations for written health materials. This is part of a wider body of literature around the effectiveness of re-writing audiology materials so they are at an appropriate level for the user. Donald and Kelly-Campbell (2016) also used readability formulas analysis to demonstrate a successful revision of a paediatric audiology report. Caposecco, Hickson, and Meyer (2011) have also used these methods. They developed written instructions for a self-fitting hearing aid with a target population of older adults. These instructions complied with recommendations for written healthcare materials. These results and those of the current study, indicate readability and suitability of written audiology materials can be improved with appropriate selection of readability and suitability factors.

Part Two: Self-efficacy and Utility testing

The finding that HA-SE was significantly higher for the group using the RG than the OG is consistent with previous research. Although there has been no prior investigation into the specific relationship between the readability and suitability of hearing aid user guides and HA-SE, aspects of Bandura's Self-efficacy (SE) theory (Bandura (1978b) and recent investigations into adequate HA-SE (Caposecco, Hickson, & Meyer, 2014), hearing aid help-seeking and success (Kricos, 2006; Meyer, Hickson, & Fletcher, 2014; Smith & West, 2006b) and performance (Dullard & Cienkowski, 2014) are in agreement with these results.

Bandura (1978b) described factors that are thought to influence SE. A number of these factors were utilised in the user guide revision. Modelling is proposed as one way of increasing SE, therefore the video was included. Graduated tasks are thought to improve SE by providing structure. In the RG, step-by-step instructions were included for hearing aid handling tasks. If simple tasks are completed first, this may build SE to persevere with the more difficult task. Simpler tasks were placed earlier in the RG than more complex tasks. It was thought that, by considering these factors, SE would be increased. This was the case, therefore, the results are supportive of Bandura's theory of factors influencing SE.

Caposecco et al. (2014) found that overall, hearing aid user guides were poorly designed for older adults. This could be a barrier to adequate HA-SE. This is in agreement with the current study's results. Not only were there significantly higher HA-SE scores for the group using the RG, but there were also significantly more participants in the RG group than the OG group who achieved adequate HA-SE scores. The effect size for differences between the OG and RG groups on the BHS and AHS of the MARS-HA was not as large as for a recent New Zealand paediatric audiology report revision (Donald & Kelly-Campbell, 2016). This difference may be due to a number of factors, but the most significant difference was the type of SE that was measured. Donald and Kelly-Campbell (2016) measured SE for paediatric audiology report reading and understanding, whereas the current study measured HA-SE. SE for comprehension of a report may be more affected by readability and suitability revisions. HA-SE may require additional clinical intervention as manual skills are being used.

Meyer et al. (2014) investigated factors in help-seeking for HI and successful hearing aid use. Participants were divided into non-consulters, consulters, unsuccessful hearing aid users and successful hearing aids users. It was found that the average score for unsuccessful hearing aid users on the BHS of the MARS-HA was 91.6 and the average score for successful hearing aid users was 98.2. In comparison, the results of the current study showed that neither group reached the average BHS MARS-HA score for successful hearing aid users (current study OG = 78.7, RG = 91.6). Because both OG and RG groups scored lower on average, there may be a confounding variable affecting the current study. For example, as the participants in the current study were not hearing aid owners, they may have been categorised as non-consulters or consulters in the Meyer et al. (2014) study. The only experience participants had with hearing aids in the current study was during data collection. The additional exposure to the hearing aids and the support of the clinicians in the Meyer et al. (2014) study likely accounted for at least some of the improvement in HA-SE. Therefore, one strength of the current study was isolating the potential confounding effects of experience and clinician support. This meant that the possible effects of improving HA-SE through revision of the user guide could be assessed.

Meyer et al. (2014) found that the average MARS-HA AHS score for unsuccessful hearing aid users was 56.3 and for successful hearing aid users was 73.7. For the current study the average score for the AHS of the MARS-HA was 70.3 for the OG group. This is below Meyer et al.'s (2014) average for successful hearing aid users. However, the RG group had a score above Meyer et al.'s (2014) average for successful hearing aid users (84.1). This could indicate that the effect the hearing aid user guide has on HA-SE influences whether hearing aid owners are successful or unsuccessful. This relationship warrants further investigation. While the user guide appears to contribute to HA-SE, additional methods may be needed to increase the BHS of the MARS-HA score from unsuccessful to successful. This could include successfully managing the task during the fitting session and verbal encouragement from the audiologist and significant others.

Utility testing scores were significantly different between the two groups as predicted. The large effect size indicates that, although the sample size was relatively small, there was a notable difference between the scores of each group when taking into account the distribution of those scores. This is in agreement with the findings of Brooke et al. (2012). When Brooke et al. (2012) used Utility testing to determine the effectiveness of hearing aid user guides provided by manufacturers, the participants experienced problems with completing tasks. Particular issues were identified with layout, content and diagrams. Some of these issues were addressed in the RG of the current study and the improvement in Utility score for the RG group indicates this has been successful. A difference in methodology was that Brooke et al. (2012) required the participants to ask for materials that were required, whereas in the current study, all required materials were provided.

As predicted, there was a positive and significant correlation between Utility testing scores and both the BHS and AHS of the MARS-HA (p = .036 and p = .038 respectively). Notably, 14.7% of the variance in a person's Utility score was accounted for by their score on the BHS of the MARS-HA. Also, 10.9% of the variance in a person's Utility score could be accounted for by their score on the AHS of the MARS-HA. This is a relatively strong result. It indicates that there is a relationship between how confident an individual is about completing a hearing aid management task and their actual performance for the task. This further highlights the importance of adequate HA-SE for hearing aid users.

It appears that HA-SE contributes to a person's hearing aid management performance. Dullard and Cienkowski (2014) looked at the relationship between HA-SE and performance of basic hearing aid skills. The Practical Hearing Aid Skills Test-Revised (PHAST-R; Doherty & Desjardins, 2012) was used to measure SE. This tool requires the clinician to make a judgement about a client's hearing aid performance. It was found that there was no relationship between the BHS of the MARS-HA and hearing aid skills, indicating SE may not predict hearing aid management skills. The PHAST-R was used to measure hearing aid skills in Dullard and Cienkowski (2014) and Utility testing was used in the current study. Hence, the method of measuring hearing aid handling skills may have contributed to this difference.

While there is limited audiology literature that formally assesses the relationship between HA-SE and hearing aid management performance, the current results are consistent with results from other disciplines including tertiary study (Wada & Yamamoto, 2014) and communication training (Gulbrandsen et al., 2013). The relationship between SE and performance may depend on what specific SE task is being measured, whether the research design is between group or within group and whether the analysis is based on individual or group performances (Yeo & Neal, 2006).

Non-significant findings

Locus of Control (LoC)

Contrary to predictions, there were no statistically significant relationships between BHS of the MARS-HA and LoC scales. It was predicted that there would be a significant relationship between the LoC scales and AHS MARS-HA scores. However, the only statistically significant result was between the AHS of the MARS-HA and the Chance Levenson scale. The correlation was extremely weak (r = .006). These results do not support LoC measurement being related to HA-SE.

A number of participants commented that there are some old-fashioned and strange questions in the Levenson scales. Some were unsure how to respond. With more participants and a different scale, a significant relationship may be found for LoC and HA-SE. Due to the small correlation and large p-value, it appears there is a chance relationship between the AHS of the MARS-HA and Chance scale of LoC. Roddenberry and Renk (2010) used a general SE measure and Levenson scales to study LoC and college student stress, illness and health service use. Contrary to the results of the current study, it was found that there was a significant relationship between a general measure of SE and a measure of academic SE. The direction of the relationships was only in agreement with the current study for some scales. As SE is situation specific, this significance might not be observed for HA-SE.

A relationship may be found using another measure of LoC. An alternative method of assessing LoC is an internal-external measure. A commonly used measure of internal-external LoC is Rotter's Internal–External (I–E) Scale developed by Rotter in 1966. A negative relationship between external LoC and a generalised measure of SE in self-handicapping and perfectionism (p = -.29, p = < .01) was found in one study (Stewart & de

George-Walker, 2014). This is consistent with the results of the current study which indicated that as Internal LoC increased, HA-SE also increased.

LoC has been the subject of initial investigation in the hearing aid literature. Laplante-Lévesque, Hickson, and Worrall (2012) used Levenson scales (Levenson, 1981) to investigate hearing and communication intervention uptake and outcomes. Cox, Alexander, and Gray (2005) also used Levenson scales to quantify characteristics of hearing aid seekers and Garsteki and Erler (1998) assessed factors influencing hearing aid use in adults over 65 years of age using Rotter's Internal-External scale (Rotter, 1996). Kelly-Campbell and Allen (2016) explored the relationship between continued hearing aid use and LoC. LoC was measured using the Origin and Pawn Scale (Westbrook & Viney, 1980) which uses content analysis to identify themes in participants' verbal responses to interview-style questions. This method of accessing LoC information has the advantage of not requiring a self-report questionnaire.

Familiarisation time

Contrary to predictions, there was not a significant relationship between familiarisation time and HA-SE. There was a small, negative, non-significant correlation between familiarisation time and HA-SE for both the BHS and AHS of the MARS-HA. This may mean that longer familiarisation time indicates less confidence in handling the hearing aids. However, limited statistical ability to detect an effect may have obscured this association. To overcome this limitation, future researchers could recruit larger numbers of participants or use one-tailed significance testing if the direction of the trend has been established.

Implications

Clinical significance

Even though there was a significant difference between the HA-SE of the OG and RG groups, this effect may not be seen in clinical situations. The effect sizes were medium and large (AHS Cohen's d= .722, BHS Cohen's d=.858). This indicates a high level of confidence in these results in a controlled laboratory environment.

As the study was conducted in a controlled environment, it is difficult to determine for an individual, whether they would have improved HA-SE from using the RG in a real world setting. For the MARS-HA BHS there was a 4.5% probability the difference between the groups was due to chance. However, for the AHS there was only a 0.8% probability that the difference between the groups was due to chance. In a real-world clinical situation there would be many other confounding factors, such as different clinicians and types of hearing aids, which means the same results may not be seen. This could also have contributed to the differences between the current results and those of Meyer et al. (2014), who found a different average MARS-HA score.

In addition, every client who is seen in a clinical situation is an individual. Readability formulas and suitability analysis can only take into account general trends and population reading level suitability (Meade & Smith, 1991). Individual factors such as culture, prior knowledge and motivation can affect how well a person understands written healthcare material (Doak et al., 1996). Therefore, each client should be considered as an individual case and the most important resources for their particular situation and requirements provided for them.

There are a variety of written audiology resources available that are specialised to a particular technology or hearing disorder, but more could be done to individualise materials. The New Zealand Audiological Society (NZAS) Audiological Counselling scope and aims document for audiologists (NZAS, 2007) includes the provision of appropriate information about hearing and tinnitus instruments, assistive listening devices and hearing loss prevention. Such resources may include information about causes of hearing loss, communication strategies or care and maintenance of hearing aids. They can be given by the audiologist or found online. For example, the American Speech-Language Hearing Association (ASHA) website contains a number of such resources, although Atcherson et al. found material on the ASHA website generally exceeds the recommended RGL.

More resources for specific populations in the New Zealand context may also be beneficial. It is projected that from 2013 to 2038 the Māori, Asian and Pacific populations will make up a larger portion of the total population (Tatauranga Aotearoa, Statistics New Zealand, 2015a). It would be beneficial for hearing care providers to have resources available in languages appropriate for these cultural groups and that are tailored for these cultures. If such resources are not readily available, their construction could be an area of future development. In lieu of such an extensive collection of written audiology information, perhaps the audiologist could make adjustments to their own written hand-out library for clients who have demonstrated a need for information in a specific form. For example, clinicians could provide a hand-out in a larger font or have resources available in Braille for clients with vision impairment.

Smith and West (2006a) suggest that HA-SE should be measured during an appointment in order to gauge how successful a client might be with hearing aids and identifying specific areas for further counselling. However, there are often time constraints in the initial hearing aid fitting appointment. Kelly-Campbell and McMillan (2015) found HA-SE does not appear to fluctuate significantly over a twelve-week period. Therefore, HA-SE could be measured in a follow-up session. This follow-up session could be when additional measures such as counselling are provided to increase HA-SE if necessary.

In a clinical situation, the video could be provided to the hearing aid user before the fitting session. This would increase confidence and familiarity going into the fitting session. It would also give the client the opportunity to clarify items they were unsure about when they saw the audiologist. This employs the vicarious learning mechanism of Bandura's SE theory . In addition, the provision of video material to refer to after the fitting session may increase SE by reducing the anxiety of attempting to remember a large amount of new information. This uses the physiological and affective states mechanism of Bandura's SE theory (Bandura, 1978b).

The improvement in HA-SE with the use of video modelling is consistent with previous health research. Video modelling has been used successfully in exercise SE for people with chronic obstructive pulmonary disease (Ng, Tam, Yew, & Lam, 1999). The video was used both before and during the exercise program. One group took part in a behavioural exercise program without the video. The other group took part in a behavioural exercise program combined with video modelling. While exercise SE improved for both groups there was a larger increase in the group with video modelling.

Maibach and Flora (1993) investigated AIDS prevention SE. Participants watched one of three videos: 1) an informational video, 2) an informational and modelling video or 3) an informational, modelling and cognitive rehearsal video. They found there was a higher level of AIDS prevention SE for the groups who watched a video that included modelling than the information only group. This supports the role of modelling in increasing SE. In the current study, the video was also associated with increased HA-SE.

As this study had a small sample size drawn from one geographic location, clinical applications would be more robust from a more extensive study. If similar results were found, then this may be informative for hearing aid manufacturers and audiologists. If more hearing aid users kept their aids and wore them successfully they could have improved communication function (Crandell, 1998), psychosocial functioning and hearing related quality of life (Chisom et al., 2007). In addition, perceived HA-SE may contribute to the use or non-use of hearing aids (Dullard & Cienkowski, 2015) and satisfaction (Kelly-Campbell & McMillan, 2015). If higher HA-SE is associated with better hearing aid outcomes, then improving HA-SE through more readable and suitable hearing aid user guides would be desirable. Audiologists can use this information to ensure that their clients are provided with user guides that are appropriate for them. This can be done by utilising as many methods as possible, discussed by Bandura for increasing SE (Bandura, 1978b), which could optimise HA-SE. Given the research documenting the benefits of and barriers to hearing aid use, audiologists may wish to consider evaluating the suitability of hearing aid user guides they provide to their clients as one way of giving their clients the best opportunity for success with their hearing aids.

Generalisability

There were significant differences between the RG group and the OG for HA-SE and Utility measures. These differences may not be observed in real-world clinical scenarios. Reasons for this include characteristics of the participant sample, future applicability and moderator mechanisms. However, the results may be applicable to future populations due to technological development.

The vast majority of the participants in the current study identified as New Zealand European ethnicity. This is not representative of the multi-cultural nature of the New Zealand population. With a more diverse sample, the results may have been different. Gheorghe, Roberts, Hemming, and Calvert (2015) looked at the generalisability of randomised control trials in pharmacology. Their findings indicated that an unrepresentative sample can limit the external validity or generalisability of a study.

Other ways in which this sample may not represent the hearing aid candidate population in NZ include: the proportion of workers, age distribution, educational level, a sample from a small geographical area and hearing aid funding status. In addition, around a third of the participants had asymmetrical impairments that may mean they feel they are functioning adequately in everyday life and may not be interested in a hearing aid. However, Lee and Noh (2015) found that when participants with a unilateral HI were fitted with a hearing aid, 68.1% continued to use it regularly.

In addition, as the participants had not sought hearing aids themselves, there may be other factors, such as lower perceived hearing handicap, that make them different from the hearing aid consulting population. This could be considered in a study design recording HA-SE in the clinic at hearing aid fitting appointments. Nevertheless, the results suggest there is an effect that warrants further investigation in a more representative sample.

Some aspects of this study indicate the results may be applicable to future populations. This includes the growing availability of media. In the United States smartphone ownership rates have increased from 35% in 2011 to 64% in 2014. Twenty-seven percent of those over 56 years of age with high education levels owned a smartphone (Pew Research, 2014). While a smartphone is not required to access the videos, if this pattern continues, smartphones could make hearing aid videos more accessible to more people including those over age 56 years.

In addition, the population is ageing and life expectancy is projected to increase (Tatauranga Aotearoa, Statistics New Zealand, 2015b) meaning more hearing rehabilitation is likely to be required. Therefore, easy access to hearing aid information for more people of retirement age would be beneficial. This could include videos available through different modalities such as smartphones, Internet or physical DVDs.

Plain language and the importance of writing at a level that can be understood is becoming more prevalent. For example, the United States signed the Plain Writing Act (2010). If plain language use continues to increase, it is likely that hearing aid user guides may also improve in readability and therefore HA-SE may also be improved.

Moderator mechanisms are other aspects of the theory that may have influenced the results (O'Shea, Moss, & McKenzie, 2007). They are specific to the individuals who took part and therefore may not be applicable to other individuals. According to Bandura's (1977) theory of SE mastery, experiences can increase or decrease SE for a task. As hearing aid management encompasses other skills, previous positive or negative experiences in these areas could mean SE is higher or lower for that individual. Possible moderator mechanisms include previous experiences with small items, experiences with technology and following instructions. In the current study these individual effects were minimised with quasi-random group assignment.

Finally, there may be cultural differences between New Zealanders and other nationalities that mean the same results would not be found overseas. For example, "tall poppy syndrome", which can be seen as demeaning those who are successful or a reluctance to stand out from the crowd (Kirkwood & Viitanen, 2015), is often associated with New Zealand national character. This could mean New Zealanders are less willing to express confidence in their abilities and may be more conservative in their questionnaire responses. Interestingly, when West and Smith (2007) developed the MARS-HA with a population sample from the United States, the average score for new users on the BHS was 93.8, which is higher than the average (85.15) for all participants on the BHS in the current study. On the other hand, the overall AHS score was higher in the current study (77.2) compared to West and Smith (2007) (63.4). There are many contributing factors so it is hard to say if this is due to cultural differences but it is likely to have had an influence.

Theoretical importance

HA-SE scores were higher for the group using the RG than the group using the OG. This was expected based on literature addressing appropriate written health materials and Bandura's SE theory (Bandura, 1978b). According to Bandura's SE theory, vicarious learning (modelling) can increase SE when an individual observes a peer complete a task successfully (Bandura, 1978b). This study aimed to use vicarious learning through video demonstration. The group using the RG and video had higher HA-SE. This was expected based on Bandura's theory. Fleming and Ginis (2004) also studied SE and video use. A repeated measures design was used to compare self-presentational SE for women watching commercial exercise videos. Lower SE was associated with the "perfect-looking" models than the "normal-looking" models. This indicates that the model used in videos can affect the SE of the user. In the current study, modelling could be further improved by using a model in the video who is more similar to the subjects, particularly in age.

Kelly-Campbell and McMillan (2015) investigated the relationship between HA-SE and satisfaction. Like the current study, over half of the participants had adequate HA-SE for the AHS of the MARS-HA. Those with adequate HA-SE also had higher hearing aid satisfaction than those with inadequate HA-SE. If causality could be determined between satisfaction and HA-SE this would indicate whether improving HA-SE could improve hearing aid satisfaction.

In addition, significantly higher HA-SE and Utility scores in the group using the RG supports Doak et al.'s (1996) theory that appropriate health materials improve comprehension and performance. All six aspects of SAM (content, literacy demand, graphics, layout and typography, learning stimulation and motivation, and cultural appropriateness) were considered in the user guide revision. This is thought to have contributed to the improved HA-SE and Utility scores. It also indicates that SAM is a beneficial tool in revising hearing aid user guides. Reading level reductions have been associated with improvements in comprehension in a number of studies (e.g. Davies at al., 1996; Young, 1990). This is another factor that could have contributed to the difference in HA-SE between the two groups. The current results are in agreement with what was expected based on these previous findings.

There were other text and layout recommendations that were adopted in the RG. These included using at least size 12 font (Caposseco, Hickson, & Meyer, 2014), minimising use of jargon (Hill-Briggs, Schumann, & Dike, 2012), including a summary (Caposseco et al., 2011), writing in second person (Hoffmann & Worrall, 2004) and including a glossary (D'Alessandro et al., 2001). These could all have contributed to the overall outcome but it is hard to attribute the difference between the groups to any one aspect of the RG. An accumulative effect of different factors may be seen. Overall, clearer presentation of information appeared to contribute to improved HA-SE and Utility performance.

Limitations

Limitations are important to discuss as part of a critical analysis of research because they can affect how the results are interpreted. If factors that could have affected the results are considered, this gives more information about the strengths and weaknesses of the study. The main challenges to the Utility of this study were confounding variables, inadequate measures, methodological shortcomings, and power.

Confounding variables

Confounding variables are factors other than the independent variable (user guide version) that may have been different between the two groups. One confounding variable is variance in user guide presentation between the two groups. Others could include functional health literacy, cognitive function, manual dexterity, and visual acuity as they were not measured in the current study. However, as the participants were quasi-randomly assigned to groups, the risk of this altering the conclusions of the study was minimised.

One such variable is the difference in presentation between the OG and RG. As the OG was professionally produced, the paper quality, size and binding were presented in a more refined way. As this was an exploratory study, the RG was produced without the benefit of professional publishing, graphic designers or printing. Therefore, the RG may have appeared less polished and professional. This could have affected confidence in the user guide. If this were the case, HA-SE would be likely to increase for the RG which could lead to even stronger results. In a more extensive study this may be remedied by seeking assistance from publishing specialists.

Another confounding variable may have been differences in functional health literacy skills between the two groups. This was not controlled for due to time constraints. If the groups had significantly different health literacy skills, this may have affected the results. If functional health literacy were to be measured in future studies, the Rapid Estimate of Adult Literacy in Medicine (REALM; Davis et al., 1991) or Test of Functional Health Literacy in Adults (TOHFLA; Parker, Baker, Williams, & Nurss, 1995) could be used.

Cognitive function may have an effect on ability to interpret user guides as it has been shown to significantly contribute to word recognition ability in older adults (Benichov, Cox, Tun, & Wingfield, 2012). Cognitive function could be measured and controlled for using a number of different measures including the Wechsler Adult Intelligence Scale, Fourth Edition (WAIS – IV; Wechsler, 1955/2008).

As managing hearing aids requires fine motor skills, manual dexterity may have affected participants' performance in Utility testing. A previous study by Kumar, Hickey, & Shaw (2000) found that greater manual dexterity was related to successful hearing aid use for data for combined behind-the-ear and in-the-ear aids. This study used the Purdue pegboard test (Trombly & Scott, 1989) to measure manual dexterity.

Visual acuity may affect the participants' ability to complete fine motor tasks and hence Utility testing scores. This, in turn, may affect SE around completing tasks with small objects. Timmis and Pardhan (2012) found that those with central visual impairment took longer and were less accurate in completing manual movements than those with normal vision. In addition, improved binocular vision and visual acuity have been related to improved fine motor skill performance (O'Conner, Birch, Anderson, & Draper, 2010). Visual acuity could have been tested using the letter eye chart (Snellen, 1862). The use of visual aids such as glasses was encouraged when participants completed the hearing aid tasks.

Inadequate measures

Due to time constraints literature testing was not carried out. Brooke et al. (2012) included a literature testing section in addition to a Utility testing section in their evaluation of hearing aid user guides. Literature testing involves locating information in the written material when asked a question. For example, "Where would you go to purchase hearing aid batteries?" or "What should you do with dead batteries?" The participants answer based on the information provided in the user guide. Literature testing may have given additional data about the ease of locating information in the user guide and knowledge that was not practical to assess using Utility testing. There may be a difference between skills and knowledge. The current study only assessed hearing aid management skills. The assessment of knowledge about hearing aids through literature testing may be additional information that could be collected in future studies.

In addition, Levenson scales were a barrier to some participants completing the testing. Several participants commented that they found the questions confusing, were worded in an unusual way and were repetitious. One participant decided not to participate in the study after having been sent the questionnaire pack because the scales were too difficult. If people were unsure how to answer the questions they may have responded inaccurately.

The difficulty with understanding the Levenson scales may have contributed to the weak and statistically non-significant correlations between HA-SE and LoC. Future research could examine the relationship between HA-SE and LoC. Alternative scales could be used such as the internal-external scales discussed in the non-significant findings LoC section above. While Levenson scale interpretation may have affected the LoC results, it does not appear to have had an effect on the main hypothesis testing of HA-SE and Utility scores. Future investigation could include a different method of LoC measurement such as the Origin and Pawn Scale (Westbrook & Viney, 1980) which was used by Kelly-Campbell and Allen (2016). This has the advantage of consisting of an interview in which questions can be tailored to be situation-specific, allowing for questions about hearing aids. Kelly-Campbell and Allen (2016) found this tool can be used reliably for assessing LoC for adults with HI. Perhaps this could help to determine if there is a significant relationship between HA-SE and LoC or if there is a relationship that has been masked in the current study by the measurement tool.

Improvements in methods used

There were aspects of the current study's methodology that should be considered in the interpretation of the results. Overall, methodological issues were kept to a minimum where they were identified. Some were due to the nature of the research and some could be remedied in future research.

Limitations of the RG became apparent during testing. A task that many participants struggled with was changing the filter. This was one of the most difficult tasks as it has a number of steps and is less intuitive than other tasks. In retrospect, improved diagrams in this section of the guide would have made the task clearer for participants. A well-defined distinction between the tool used to change the filter and the MultiTool would also have made this section stronger. In addition, one participant noted that a MARS-HA question referred to a mould/tube, which was not used with the Oticon Alta RIC style hearing aid.

There could have been an order effect in the Utility testing section. The Utility testing matrix tasks were done in the same order for all participants. For example, scores on earlier tasks may have been improved because of greater concentration or the scores could have been poorer because participants were unfamiliar with the format. However, as the order was the same for both groups if there was an effect it likely would have been the same for both groups. There was not a big enough sample size to randomise the tasks with a sufficient number completing each order. If a study were conducted with a larger sample size it may be possible to randomise the order of the tasks.

Further possible confusion came from asking the participants to complete the Utility testing tasks verbally. This was based on the procedure used by Brooke et al. (2012) and the instructions were scripted in order to ensure consistency between participants. However, due to the inclusion criteria of the study, all participants had a hearing loss and none of them wore hearing aids. Therefore, instructions could have been misunderstood or misheard. Instruction clarity could be remedied in future research with visual as well as verbal instructions. While these factors may have influenced the results, because the groups were randomly assigned and there was no significant difference between them in hearing thresholds, results would likely have been equally affected for both groups.

While the readability and suitability scores met the health literacy guidelines they could be further improved with editing of the legal information section of the user guide. In the RG the legal information section was retained as it was in the OG. This meant the readability was more difficult than if this section had not been included or revised for readability. With the legal information section included readability scores were F-K = 5.0 RGL, Flesch = 75.8, SMOG = 6 RGL. Without the legal information section included readability scores were F-K = 2.8 RGL, Flesch = 98.2, SMOG = 5 RGL. In future research revisions could be done with the advice of a lawyer about what information and wording is required. If the information is important enough to be included in the guide, then it should be worded in a way that the user can understand.

Power

Overall, there was adequate power for significant between group differences for the BHS of the MARS-HA ($1- \beta = .85$), Utility testing ($1- \beta = >.85$) and the Chance Levenson scale ($1- \beta = .85$). This indicates that there is an acceptable probability of detecting a real effect as the values exceeded Cohen's (1988) suggested minimum of .80 for statistical power. However, for the AHS of the MARS-HA the power could have been improved ($1- \beta = .77$). Non-parametric testing was used to calculate the significance between groups. This testing method does not rely on normal distribution. In a more extensive study with normal distribution where parametric testing could be used, the results may be different as measured values could be used for analysis instead of rank-order values.

For the non-significant between group differences, the power was > .50 for both Internal LoC and Powerful Others Levenson scales. This meant there was insufficient probability of correctly rejecting a false null hypothesis. This was likely due to the relatively small effect sizes (Internal LoC d= .134, Powerful Others d= .492). In addition, there was a large amount of variation in scores as seen in the large standard deviations for these scales and is reflected in the weak effect sizes. A post-hoc calculation was done to determine how many participants would be required in future studies to detect this effect size. In a study with normal distribution where parametric statistical testing could be used, at least 64 participants would be required in each group in order to detect these differences.

The effect sizes were medium for AHS of the MARS-HA (d= .722) and large for the BHS of the MARS-HA (d= .858) and Utility scores (d= 1.26). A Cohen's d value of over .50

indicates a medium effect size or of moderate practical importance. A Cohen's *d* value of over .80 is large or of crucial practical importance. However, these values also need to be interpreted in the context of the study (Cohen, 1988).

Future Research

The results of this study have the potential to be informative for clinicians. However, there are areas that have become apparent that warrant further investigation. Future research in the areas of familiarisation time and HA-SE, the effect of the clinician on HA-SE, the appropriateness of manufacturer instructional videos, personalisation of hearing aid user guides, self-modelling through smartphone technology and the role of counselling on HA-SE would be advantageous.

It would be beneficial to have more information about the relationship between familiarisation time and SE. The results of the current study indicated a weak, slightly positive and statistically non-significant relationship between SE and familiarisation time and a weak, negative and non-significant relationship between familiarisation time and Utility testing. This result is inconclusive. If people choose to take longer during familiarisation they may be more thorough or more uncertain about the tasks. Further investigation into this relationship could help inform recommendations for hearing aid management practise time at home and in the clinic. In addition, if participants were not sitting in a controlled laboratory setting they may have taken more or less time to familiarise themselves with the user guide. A way to avoid this problem would be to provide participants with hearing aids and user guides to take home and ask them to self-report familiarisation time.

Since the data were collected, a new user guide has become available for the Alta on the Oticon website. There are also videos clips available on the website demonstrating hearing aid handling skills. Future research could include an assessment of the suitability of videos provided on the Internet by manufacturers in addition to written user guides. This could be useful in determining whether they are appropriate for the target user. The videos on the Oticon website at the time of writing are available for different hearing aid styles including the mini Receiver-in-the-ear (RITE) style. Overall, the Oticon videos were similar in content to the videos used in the study. The model was a person more similar in age to the average hearing aid user than the current study. However, the tasks were described verbally instead of being written in captions on the screen, which may have been difficult for individuals with HI to follow. Further analysis of manufacturer video suitability is warranted.

Another recent development in hearing aid user guides that could be an area of further research is user guides that can be personalised. Some personalised hearing aid setting summary reports are available that can be printed with personal settings at the end of a hearing aid fitting session. These are included in some manufacturers' software and include information such as what happens when the buttons are pressed and which programs correspond to which listening situations. They have the advantage of including the most important information that the client may initially be interested in, in a short one- or two-page printout. They may also include a line diagram, which can be beneficial for understanding. This could be looked at in relation to HA-SE and in conjunction with more extensive forms of user guide. Evaluation of these personalised summaries could also include readability and suitability analysis.

Healthcare information is becoming more ubiquitous because of the development and prevalence of personal computing devices (Hussain, Yang, Laforest, & Verdier, 2008). This is known as the pervasive healthcare model. Such devices could provide a useful, portable tool for hearing aid users competent in the use of technology. As technology develops, video manuals may be developed specifically for portable devices such as smart phone applications. Future research could assess the suitability of these applications for hearing aid users taking into account readability and Utility factors. Features such as a search function for specific questions could be incorporated in future smartphone user guides. Development of phone applications that comply with recommended written healthcare material guidelines could be a future area of investigation.

Self-modelling via video feedback could also be investigated as a method for increasing HA-SE. For example, as smartphones become more prevalent, the audiologist could video the client completing a task proficiently on their own smartphone. This would be used for future reference when they are at home and decrease anxiety of trying to remember a lot of information during the appointment. Video feedback has been used previously for SE for giving an impromptu speech by Rodebaugh and Chambless (2002). SE was found to be predictive of change. Future studies could measure the difference between modelling and self-modelling videos.

The clinician is also likely to have a role in promoting HA-SE that is currently unexplored. Individual factors such as rapport building, personality, similarity in age, gender of culture to the client and confidence in their own abilities may influence the HA-SE of the client. The researcher was kept constant in the current study in order to reduce this variation, however, future studies could compare the HA-SE of groups with clinicians who vary in these areas to determine if there is a significant difference in HA-SE.

Improving hearing aid user guides may be one way of improving HA-SE, however, there are still many more avenues to be explored. Counselling is an important part of the hearing aid orientation process. It can focus on different aspects of the fitting such as aid orientation (Reese & Smith, 2006) and realistic expectations (Saunders, Lewis, & Forsline, 2009). Audiologists could use counselling time to encourage mastery experiences of hearing aid management and to encourage the client through verbal persuasion (Bandura, 1997). West and Smith (2006) recommend constructive comments and realistic feedback to help increase HA-SE. Again, there is limited research in this area. Different approaches could be explored for installing self-confidence in the client. For example, a study could be designed so that the same clinician used no encouragement for one group and encouragement for the other group before measuring HA-SE.

Conclusion

HA-SE is receiving a growing amount of attention in the audiology literature because of its potential relationship with hearing aid uptake, use and satisfaction. Research indicates hearing aid user guides are currently not written at an appropriate level for the majority of users. The aim of this study was to investigate whether improving the readability and suitability of a hearing aid user guide was associated with improved hearing HA-SE and Utility performance for hearing aid management.

The results indicate that, as hypothesised, the revision of a hearing aid user guide for readability and suitability is associated with significantly improved HA-SE. This is an encouraging result as it indicates that there is the potential to improve HA-SE with appropriately designed written material. Some caveats such as the size and nature of the participant sample, however, must be taken into account when applying these results to a clinical situation.

The user guide revision was also associated with improved performance on hearing aid handling tasks. This was the result with the largest effect size, which is a promising indication for the practical benefits of suitable and readable instructions. These improvements in performance could reduce frustration, the need for additional appointments and increase success with the hearing aids.

There is much more research to be done into other methods of increasing HA-SE and the role of HA-SE in the clients' hearing aid experience. However, improving the readability and suitability of hearing aid user guides is one area that may contribute to improved hearing aid use satisfaction. Together with other initiatives improved HA-SE could lead to better hearing related quality of life for individuals with HI.

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Appendix A: Human ethics committee approval

UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

HUMAN ETHICS COMMITTEE

Secretary, Lynda Griffioen
Email: human-ethics@canterbury.ac.nz

Ref: HEC 2015/32

6 May 2015

Alexandra Ross
Department of Communication Disorders
UNIVERSITY OF CANTERBURY

Dear Alexandra

The Human Ethics Committee advises that your research proposal "Relationship of readability and suitability of hearing aid user guides and self-efficacy of hearing aid users" has been considered and approved.

Please note that this approval is subject to the incorporation of the amendments you have provided in your email of 5 May 2015.

Best wishes for your project.

Yours sincerely

Lindsey MacDonald
Chair
University of Canterbury Human Ethics Committee

University of Canterbury Private Bag 4800, Christchurch 8140, New Zealand. www.canterbury.ac.nz

F E S

Appendix B: Advertising poster

Hearing Aid Guides & User Confidence Study

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CHRISTCHURCH NEW ZEALAND

We want to know if clearer hearing aid user guides help people feel more confident about using their hearing aids.

If you take part you will receive:

- A **free hearing check**
- A **$10 fuel voucher**

You can take part if you:

- **Have trouble hearing**
- Have **never used hearing aids**
- Are over **18 years** old

If you take part you will be asked to:

- Fill out a questionnaire at home about yourself and how confident you feel about caring for hearing aids
- Spend time getting to know the hearing aid guide
- Complete hearing aid tasks e.g. turning it on
- Answer questions about your hearing and how much you feel you can control events around you

The research will take about an hour.

It will happen at the University of Canterbury.

Hearing Aid Guide & User Confidence Study
03 364 2987 extension 8327
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Appendix C: Information sheet

University of Canterbury
Department of Communication Disorders
Private Bag 4800
Christchurch 8140
Email: alexandra.ross@pg.canterbury.ac.nz

"Relationship of readability and suitability of hearing aid user guides and self-efficacy of hearing aid use".

Information Sheet

You are invited to take part in a research project. It is called "Relationship of readability and suitability of hearing aid user guides and self-efficacy of hearing aid use".

My name is Alexandra Ross. I am a Master of Audiology student from the University of Canterbury (UC). I am working on a research project as part of this degree. In the first part of my study I aim to make an existing hearing aid user guide easier to read and understand. In the second part of my study I will investigate whether this change helps people feel more confident about using their hearing aids.

If you agree to participate in this project you will complete some hearing aid tasks e.g. turning them on, changing the battery. You will use either the original hearing aid user guide or the revised hearing aid guide for these tasks. Your responses will be recorded with a video camera. There will also be questionnaires about your confidence with the hearing aids, hearing and how much control you feel you have over random events. You will be asked to give general information using a questionnaire. Overall, the session is expected to take an hour.

It is entirely your own decision to participate in this study. A set of documents (Consent form, and Demographic Questionnaire) will have been given to you along with this Information sheet, however you do not need to return them until your appointment at the University of Canterbury; therefore you have time to consider whether or not you would like to participate. The risk of participating in this study includes the possibility of feeling distressed as you complete the hearing aid tasks and fill in the questionnaires. A list of available support services is provided at the end of this document. Please note that the costs incurred by using these services will not be covered by this research project.

A thesis is a public document and will be available through the UC Library. However, the greatest care will be taken to make sure your information is kept confidential. The results of the project may be published, but please be assured of the complete confidentiality of your data. Only my supervisors and I will have access to the obtained data. This data will be stored in a secure, locked room for five years at which point it will be destroyed. If you would like a copy of the project results, please tick the appropriate box on the consent form.

You may withdraw from the study until 30 September 2015. After that date, the information you provided will be added to the dataset and cannot be removed.

The project is being carried out as part of the requirement for the Master of Audiology by Alexandra Ross. It is under the supervision of Dr Rebecca Kelly-Campbell. We are happy to discuss any concerns you may have about being part of the project.
Dr Rebecca Kelly-Campbell can be contacted on:
64 3 364 2987 ext. 8327
rebecca.kelly@canterbury.ac.nz
University of Canterbury, Private Bag 4800, Christchurch, New Zealand, 8140

This project has been reviewed and approved by the University of Canterbury Human Ethics Committee.
The Human Ethics Committee can be contacted at:
64 3 364 2987
human-ethics@canterbury.ac.nz
Secretary, Human Ethics Committee, Private Bag 4800, Christchurch, New Zealand 8140

Additional information is available from:

Available support services:
New Zealand Association of Counsellors 07 834 0220 (National Office) http://nzac.org.nz/nzac_counsellor_search.cfm
New Zealand Audiological Society http://www.audiology.org.nz/ 0800 625 166 mail@audiology.org.nz
Ministry of Health http://www.health.govt.nz/about-ministry/contact-us 0800 855 066 info@health.govt.nz

Appendix D: Consent form

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UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

"Relationship of readability and suitability of hearing aid user guides and self-efficacy of hearing aid use".

I have been given a full explanation of this project. I have had the opportunity to ask questions. I understand what I will do if I agree to take part in the research.

I understand that participation is my decision. I may decide not to take part at any time without penalty. If I decide not to participate, any information I have given will be removed until 30th of September 2015. This is when it will be included in the dataset.

I understand that any information or opinions I provide will be kept confidential to the researcher and the researcher's supervisor. Any published or reported results will not identify the participants. I understand that a thesis is a public document and will be available through the UC Library.

I understand that all data collected for the study will be kept in locked and secure facilities and in password protected electronic forms. It will be destroyed after five years.

I understand the risks associated with taking part and how they will be managed. I understand that I can receive a report of the findings of the study by ticking the box below.
I understand that I can contact the researcher Alexandra Ross or Dr Rebecca Kelly-Campbell for further information.
Dr Rebecca Kelly-Campbell can be contacted at:
64 3 364 2987 ext. 8327
rebecca.kelly@canterbury.ac.nz
If I have any complaints, I can contact the Chair of the University of Canterbury Human Ethics Committee at:
64 3 364 2987human-ethics@canterbury.ac.nz
Secretary, Human Ethics Committee, Private Bag 4800, Christchurch, 8140
Please tick a box below to indicate if you wish to receive a copy of the final report
☐ Yes, please send me a copy of the final report.
☐ No, I do not want a copy of the final report.

By signing below, I agree to participate in this research project.

Signature: ____________________________ Date: ______________________

Appendix E: Demographic questionnaire

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"Relationship of readability and suitability of hearing aid user guides and self-efficacy of hearing aid use".

Demographic questionnaire:

Date: ______________ Current age: ____________ Gender: ________________

1. What ethnic group do you belong to?

☐ New Zealand European ☐ Tongan
☐ Maori ☐ Niuean
☐ Samoan ☐ Chinese
☐ Cook Island Maori ☐ Indian
☐ Other, such as Dutch, Japanese, Tokelauan. Please state: ________________

2. What is your relationship status? (please tick one box)

☐ Single ☐ Never married
☐ Married ☐ In a committed relationship
☐ Widowed ☐ Divorced
☐ Separated

3. What is the net annual income of your household? (please tick one box)

☐ $0 – $25,000 ☐ $25,000 - $50,000
☐ $50,000 - $75,000 ☐ $75,000 - $100,000
☐ more than $100,000

4. What is the highest level of education you completed? ______________________

5. Are you currently working?

☐ Yes ☐ No

If so, what is your occupation? ______________________________________

6. On a scale of 1 to 10, how would you describe the severity of your hearing problem (1 = not at all severe, 10 = very severe)? ______________________________________

7. Have you ever applied for a hearing aid government subsidy?

   ☐ Yes ☐ No

8. Have you been eligible for any other hearing aid funding?

   ☐ Yes ☐ No

   If so, please list other funding sources: ______________________________________

Signature: ______________________________ Date: ______________________

Appendix F: Utility tasks and scoring sheet

Task	***Required elements***	***Points (Single)***	***Points (Total)***	***Points (Given)***
Insert hearing aid *"Can you show me how to put a hearing aid on so you are ready to use it?"*	1. Make sure the battery door is shut 2. Place dome into ear canal 3. Completely so that the tubing is taut 4. Place case behind ear 5. Aid placed in correct ear	1 1 1 1 1	5	
Remove hearing aid *"Can you show me how to take the aid off?"*	1. Remove dome from ear 2. Remove case from behind ear 3. Open the battery door	1 1 1	3	
Clean hearing aid *"Imagine you have worn the aid all day. How would you clean it when you took it off at night?"*	1. Use cloth to rub wax from dome 2. Clean a microphone opening with the brush 3. Clean all microphone openings 4. Check the filter for wax	1 1 1 1	4	
Increase volume *"How do you make the aids louder?"*	1. Press volume button 2. On the *right* aid	1 1	2	
Decrease volume *"How do you make the aids softer?"*	1. Press volume button 2. On the *left* aid	1 1	2	
Replace the battery *"Imagine the battery in the hearing aid has gone flat. Can you show me how to replace it?"*	1. Open battery door 2. Remove old battery 3. Remove sticker from new battery 4. Place battery in aid, correct side up 5. Close battery door	1 1 1 1 1	5	
Replace the dome *"Imagine the dome is cracked. Can you show me how to replace it?"*	1. Pull the old dome off 2. Take a new dome form the packet 3. Press the new dome on (partial)	1 1 1	3	
Replace the filter *"Imagine the filter is blocked with wax. Can you show me how you would change it?"*	1. Remove the old filter 2. Get a new filter 3. Take the old filter off 4. Push the *new* filter on	1 1 1 1	4	
Turn hearing aid off *"Please show me how to turn the hearing aids off"*	1. Open battery door (partial)	1	1	
Turn hearing aid on *"Please show me how to turn the hearing aids on"*	1. Close battery door (partial)	1	1	
Total		**30**	**30**	

Appendix G: Revised user guide sample

Using your hearing aids

How to tell left from right

The **RIGHT** aid has **RED** markers.

The **LEFT** aid has **BLUE** markers.

The markers are:

- Under the **dome,** and
- In the **battery door.**

How to turn the aids **on** and **off**

To turn the aids **on**:

1. Make sure the battery is in the battery door **flat side up**.
2. Shut the **battery door** completely.

- The aids will play a start-up **tune** so you know they are on.
- To tell if it is on, clasp it in your hand. If it is working it will **whistle.**

To turn them **off** again open the battery door.

- **Half** opening the battery door turns them off.
- Open the battery door **all the way** at night to let air in.

When you open and close the battery door the volume will reset.

Putting your hearing aids on

1. **Shut** the battery door.

2. **Sit** the body of the aid behind your ear.

3. Use your thumb and forefinger to **push** the dome into your ear.

Check in the mirror to make sure:

- The **dome** is not visible and
- The **wire** is flat against your face.

Tip: Try pulling the back of your ear away from your face. This can help the dome slide into your ear.

Taking your hearing aids off

1. Move the body of the aid **over** your ear from the back to the front.
2. **Twist** the dome out of your ear.
3. **Open** the battery door to turn the hearing aid off.

Changing the **battery**

The batteries are size **312**. They are in **brown** coloured packets.

When the battery is **almost** flat you will hear **2 beeps**.

When the battery **is** flat you will hear **4 beeps**.

You can buy batteries from:

- Your audiologist,
- Supermarkets,
- Pharmacies may also have them.

How to **change** the battery:

1. Pull the battery door open.
2. Take out the old battery. The magnet on the MultiTool may help with this.
3. Take the sticker off the new battery.
4. Place the new battery in the battery door. Make sure the flat positive (+) side is facing up.
5. Shut the battery door.

What to do with **flat batteries**:

- It is best to recycle them. Your audiologist may collect them for recycling.
- They can be thrown out but do not burn them.

Changing the **dome**

Change the dome about **once a month**.

Change your dome if it is:

- Discoloured
- Brittle

How to change a dome:

1. **Pull** off the old dome. It may be stiff.
2. Take a new dome **out** of the packet.
3. **Place** it on the speaker and **press** on firmly.

Changing the **filter**

You may need to change the filter:

- If you can see it is **blocked** with wax or
- If the sound from the aid is **faint.**

How to change the filter:

1. Take the dome off.
2. Take a new filter from the packet.
3. Click the empty side of the tool into the filter. Pull it out to remove the old filter.
4. Throw out the old filter.
5. Use the tool to click the new filter into place.
6. Put the dome back on again.

Heat and chemicals

It is not good for your hearing aids to be **hot**.

Keep them out of:

- The microwave
- The oven
- Cars sitting in the sun

Some **chemicals** can get into your hearing aids.

- Use hairspray/aftershave **before** putting your hearing aids on.
- Wash and dry your hands after using products like sunscreen and cosmetics. Then put your hearing aid on.

Water resistance

Your hearing aids repel water. They are not waterproof.

If your hearing aids get **wet** you should:

1. **Wipe** them dry.
2. Take the **battery** out.
3. **Wipe** any water out of the battery door.
4. Leave the battery door open for **30 minutes**.
5. Put a **new battery in.**

If the hearing aids are not working contact your audiologist.

If your hearing aids often get damp you can use a **drying kit**. This draws the moisture out overnight. A drying kit can be bought from your audiologist.

Do not:

- Wear your hearing aids in the **shower.**
- Wear your hearing aids **swimming.**
- Cover your hearing aids with **water.**

Fixing common problems

Problem	Cause	Solution
Whistling	Too much ear wax in your ear.	- Have your audiologist or doctor check your ear.
	Aid not in the ear properly.	- Check the wire is flush against your face. - Check the dome is completely in your ear.
Reduced sound	Flat battery.	- Replace the battery.
	Wax is blocking the speaker.	- Wipe the dome with a dry tissue. - Use the MultiTool to brush or pick wax from the tip.
No sound	Flat battery.	- Replace the battery.
	Wax is blocking the speaker.	- Wipe the dome with a dry tissue. - Use the MultiTool to brush or pick wax from the tip. - Check the filter for wax.

If you need more help call your audiologist.

	Summary
Using your hearing aids	The **right** aid is marked **red** and the **left** aid is marked **blue**.
	Shut the battery door to turn them **on**. Open the battery door to turn them **off.**
	The button on the **right** aid turns the volume **up**. The button on the **left** aid turns the volume **down**.
Looking after your hearing aids	**Clean** them every day. **Wipe** the dome with a dry tissue and **brush** the body of your hearing aid.
	How to **change the battery**: o Open the battery door. o Remove the old battery. o Peel the sticker off the new battery. o Put the new battery in with the flat side up. o Shut the battery door all the way.
	Change the **dome** and **filter** if they get old or dirty.
	Keep your hearing aids away from **heat** and **chemicals**.
	If the hearing aids get **wet** open your battery door so it can dry.
Solving **common problems**	If your hearing aids **do not sound right** it might be because:
	- There is a lot of **wax** in your ears.
	- Wax is stuck in the **dome** or **speaker** so the sound cannot get out.
	- The **battery** is flat.

Glossary

Term	Meaning	Page
Audiologist	Helps people with hearing problems.	8, 10, 12,13
Autophone	A feature to make the telephone easier to hear.	8
Autophone magnet	A magnet you can attach to your telephone to enhance the signal.	8
Autophone mode	The mode your hearing aid uses on the telephone.	8
Battery	The cell that powers your hearing aid.	5, 6, 10, 12, 13, 14
Battery 312	The battery size for Oticon Alta hearing aids.	10
Battery door	At the bottom of your hearing aid where the battery sits.	5, 6, 10, 12, 14
Blocked	When dirt stops your hearing aid working.	11, 13
Body of hearing aid	The main piece that sits behind your ear.	6, 14
Booklet	The written hearing aid guide.	3
Brush	Found inside your MultiTool.	9, 13, 14
Button	A control on the body of your hearing aid.	7, 14
Chemicals	Liquids that might harm your hearing aid.	12
Clicks	Sound made by the hearing aids when you change the volume.	7, 11
Computer chip	What the hearing aid uses to process sound.	4
Dome	A soft plastic tip that keeps the speaker in your ear.	4, 5, 6, 9, 11, 13, 14
Drying kit	A box with moisture absorbent crystals for drying your hearing aids.	9, 12
Faint	If the sound is quieter than usual.	11

Filter	A piece at the end of the speaker to stop wax.	4, 9, 11, 14
Flat battery	When the battery has no more charge.	10, 14
Half open	When your battery door has clicked once but is not fully closed.	5
Microphone	Picks up sounds and speech.	4, 8, 9
MultiTool	Used to look after your hearing aid.	9, 10, 13
Mute	When the aids are on the silent setting.	7
New battery	A charged battery with the brown sticker still on it.	10, 12, 14
Open dome	A tip that lets some natural sound into your ear.	4
Rating sound quality	Rating for how well mobiles phones and hearing aids work together.	8
Reduced sound	If the hearing aid is quieter than usual.	13
Short press	Push the button for about 1 second.	7
Sound	The noises going in and out of your hearing aids.	4, 8, 11, 13, 14
Speaker	Plays the sound into your ear.	4, 11, 13, 14
Tip	Hint to help with a task.	6, 8
Uneven sound	Sound cuts in and out.	13
Video (clip)	Shows you how to do things.	3
Volume	How loud or soft the sound of the hearing aid is.	5, 7, 14
Volume button	Found on the back of the aid.	7
Whistling	A high pitched squealing sound.	5, 13
Wire	Running from the body of the aid to the speaker.	4, 6, 13